APRIL ISSUE 1961

83.

Published by
THE BRITISH SULPHUR CORPORATION LIMITED
FISON HOUSE
95 WIGMORE STREET
LONDON, W.1

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Annual Subscription £21
Reprints of individual articles obtainable on application to the Advertising Manager

Printed by
The Essex Chronicle Series
Chelmsford, Essex

SULPHUR

THE MAGAZINE OF WORLD SULPHUR

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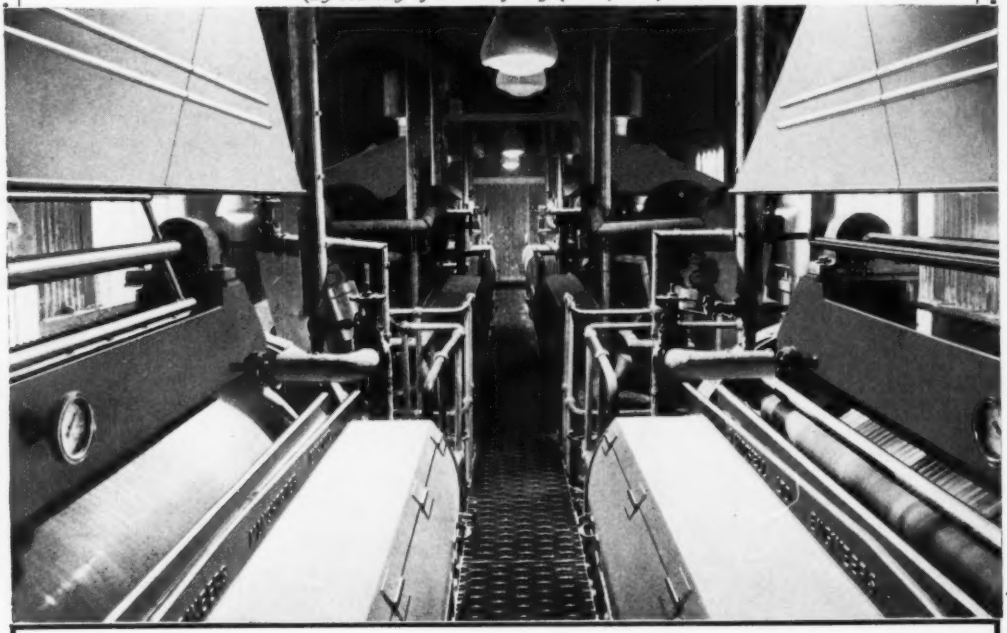

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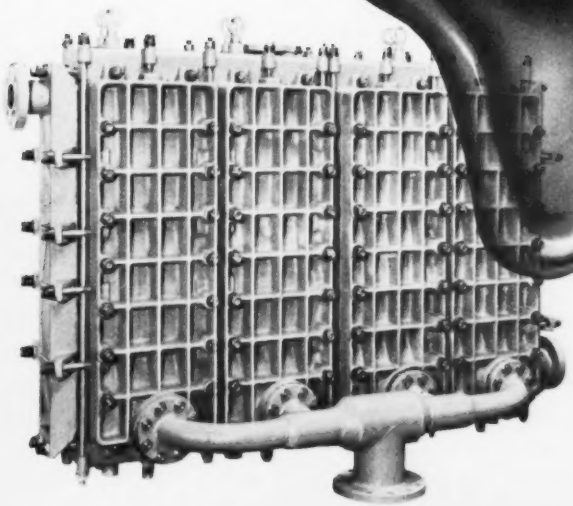

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WORLD TRADE IN BRIMSTONE 1960

Spectacular Growth Due to Increased Demands in U.K. and Western Europe

GROWTH of world-wide demand raised the level of world trade in brimstone to over 3.6 million tonnes in 1960, an increase of 592,000 tonnes (19.6%) over 1959. Exports originated almost entirely from six major producing countries, U.S.A., Mexico, France, Canada, Norway and Italy, of which the U.S.A. remained the largest accounting for one-half of world trade; and the combined exports of U.S.A., Mexico and France represented 94%.

This contrasts with the supply pattern prevailing until the mid-1960's when the bulk of world trade was represented by U.S. sulphur and Italy still accounted for up to 15% of world exports, Norway for up to 5% and other sources of supply included Chile and other South American native ore producers and occasionally Japan.

The spectacular increase in world trade is attributable primarily to booming demand in the U.K. and Western Europe and shipments to these countries, which received 40% of world exports, rose 348,000 tonnes or 58.8% of the additional tonnage shipped in 1960.

EXPORTING COUNTRIES

The principal change in the pattern of export supplies is occasioned by the mounting level of exports of brimstone recovered from sour natural gas which, originating primarily from France and increasingly from Canada, rose to nearly 540,000 tonnes or 15% of total world trade.

Brimstone trade between the Free-world and Communist countries is negligible. About 55,000 tonnes was shipped to Eastern Europe, whereas exports from the U.S.S.R. to the West —notably to Finland, Western Germany, Belgium and Sweden—totalled under 30,000 tonnes.

Trade between Communist countries in 1960 is estimated to have totalled 200,000 tonnes brimstone, supplied mainly by China, U.S.S.R. and to a small extent by East Germany.

U.S.A.

Exports of 1.79 million tonnes in 1960, the highest on record, were 153,000 tonnes (9.3%) greater than in 1959. Supplies originated from four of the five U.S. Frasch sulphur producers—in proportion to their holding in the Sulphur Export Corporation (Sulexco) which sells abroad on their behalf.

Notwithstanding Sulexco's success in increasing the actual level of U.S. brimstone exports, the U.S. share of world trade continued to decline and in 1960 amounted to 49.5%.

This decline was inevitable as the U.S.A. was, up to 1956, almost the sole supplier of all brimstone importing countries, but the impact of the competition from the new sources of supply, notably Mexico and France, was mitigated by the natural growth of markets.

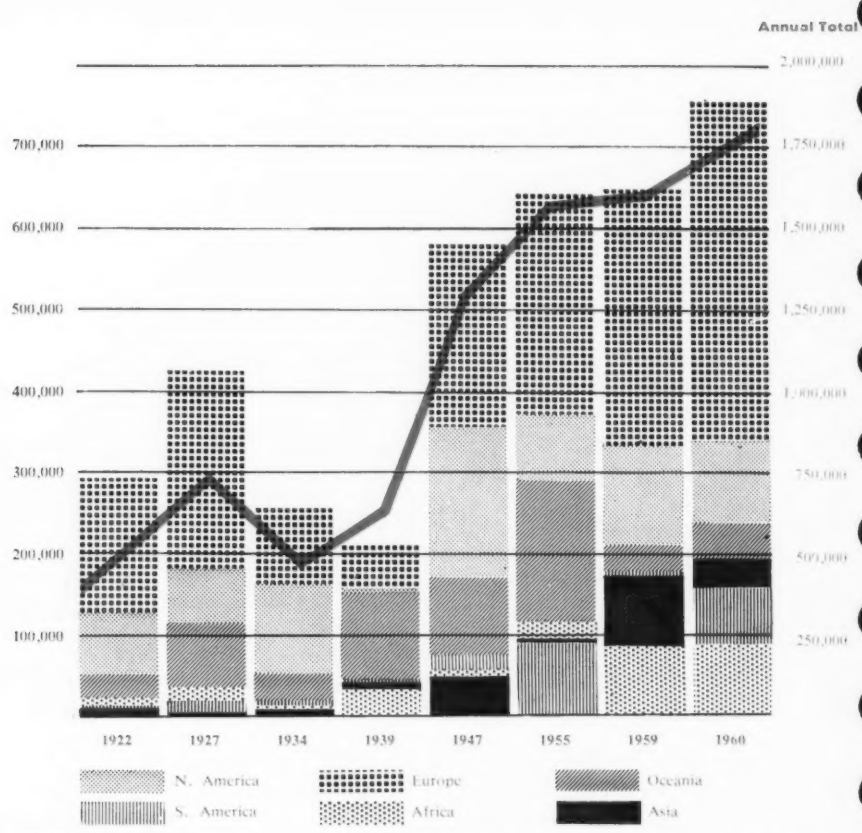
Sulphur Supply Pattern

	1960		1959		1950	
	tonnes	%	tonnes	%	tonnes	%
U.S.A.	1,790,716	49.5	1,637,959	54.1	1,303,666	80.0
Mexico	1,189,590	32.9	1,046,764	34.6	641	—
France	409,381	11.3	217,400	7.2	2,358	0.1
Canada	129,763	3.6	24,063	0.8	—	—
Italy	46,708	1.3	34,322	1.1	239,721	14.7
Norway	51,500	1.4	65,454	2.2	76,160	4.7
Others	*		*		8,248	0.5
Total	**3,617,658**		**3,025,962**		**1,630,794**	

* Estimated at under 2,500 tonnes; representing small quantities of recovered sulphur in Western Europe and sulphur from native ores in South America (not included in total).

N.B.—In a number of tables quantities are shown to the nearest 100 tonnes; in consequence there are apparent discrepancies in the additions.

U.S. EXPORTS OF CRUDE SULPHUR
('000 Long Tons)



Export Market for U.S. Sulphur

U.S. sulphur exports are represented in virtually every individual sulphur market, of which the most important are Western Europe, Canada, Australia and New Zealand, India, South Africa and Brazil. The broad pattern of distribution of U.S. exports is as follows:—

	1960 %	1959 %	1955 %	1939 %
Europe	41.4	40.0	39.8	32.8
North America ...	17.6	17.8	23.2	26.1
South and Central America ...	11.9	13.1	5.8	6.3
Asia	10.5	10.7	5.8	6.3
Africa	5.5	5.6	7.1	4.2
Australasia ...	13.1	12.8	18.3	25.3
million tonnes	**1.79**	**1.64**	**1.62**	**0.64**

North America. Although the level of exports has dropped from the peak of over 406,000 tonnes in 1956 Canada is still the largest single customer of the U.S. suppliers—315,000 tonnes in 1960—and the loss of the Western Canadian market during the past two to three years to indigenous supplies, has focussed the entire U.S. export trade in Eastern Canada where for the time being it is immune from competition from Canadian recovered sulphur supplies other than the as yet small quantities arising at oil and nickel refineries. Here U.S. sulphur enjoys a freight advantage over Mexican supplies, although not at present over French sulphur should the latter seek an outlet in Canada.

Europe. Exports to Western Europe, traditionally the largest outlet for U.S. sulphur, increased 13.4% in 1960 to 742,000 tonnes.

In this marketing area U.S. sulphur is most exposed to competition from both Mexico and France and the favourable results achieved in 1960 are as much the result of the booming brimstone demand as of the active sales policy pursued by Sulexco.

Important advances were made in the British and Dutch markets and to a lesser extent in Belgium and Finland. In these countries sulphur needs expanded strongly. Although the requirements of the German

U.S. Exports Centre

Western Europe	1960	1959	Change	
	'000 tonnes		'000 tonnes	%
Austria ...	7.1	10.2	− 3.1	− 30.0
Belgium ...	69.0	54.5	+14.5	+ 27.0
Denmark ...	—	1.0	− 1.0	−100.0
Finland ...	20.4	12.8	+ 7.6	+ 59.0
France ...	73.4	87.3	−13.9	− 16.0
Germany ...	68.7	87.7	−20.0	− 12.0
U.K. ...	314.1	277.6	+36.5	+ 13.0
Netherlands ...	77.4	42.5	+34.9	+ 82.0
Norway ...	7.0	—	+ 7.0	—
Spain ...	10.0	—	+10.0	—
Sweden ...	17.5	10.0	+ 7.5	+ 15.0
Switzerland ...	39.1	35.3	+ 3.8	+ 11.0
Eastern Europe				
Yugoslovia	—	2.0	− 2.0	−100.0
Poland ...	19.1	22.7	− 3.6	− 16.0
Czechoslovakia	19.3	10.8	+ 8.5	+ 7.9
Total ...	**742.0**	**654.3**	**+87.7**	**+ 13.0**

market rose by over 40% in 1960 U.S. exports declined mainly as a result of intensive Mexican competition. In 1960 trade with Poland and Czechoslovakia rose by nearly 5,000 tonnes to 38,400 tonnes.

Other Countries. The lesser growth of these markets in 1960 in which U.S. sulphur generally meets only competition from Mexico was largely the cause for the increase of U.S. exports being only 42,100 tonnes or 7.1%. Shipments to Asia, Africa and North, Central and South America totalled 733,600 tonnes of which nearly 30% was directed to Central and South America and 20% to India and Pakistan. Outside Europe there are only nine markets with total annual requirements in excess of 25,000 tonnes brimstone and to these U.S. shipments were as follows:—

	1960	1959
	'000 tonnes	
Israel	20.3	25.5
Australia	149.4	125.1
New Zealand	85.0	85.4
Canada	315.0	292.1
India	144.2	126.7
Tunisia	25.7	16.1
South Africa	58.9	62.4
Argentine	21.8	33.3
Brazil	130.9	128.4

Near East and Asia. Small, but nevertheless important, regular consumers of U.S. sulphur in the Middle and Far East were Iran (7,000 tonnes), Saudi Arabia (1,200 tonnes), Burma (1,000 tonnes), Korea (700 tonnes) and Pakistan (2,200 tonnes). The Egyptian region of the U.A.R. recommenced purchasing American material in 1960 (5,100 tonnes) and Thailand made its first purchase of sulphur (500 tonnes) to meet the needs of the country's first acid plant. Shipments to Indonesia declined by over 50% to 3,100 tonnes, partly because of Mexican competition but also due to lower demand. Shipments to Taiwan rose to 12,600 tonnes compared with 2,400 tonnes in the previous year, in response to the increased sulphur demand for sulphuric acid for fertilizer manufacture.

Africa. In terms of tonnage, exports at 92,900 tonnes were almost identical with the previous year's. Shipments to South Africa, the most important market, however, declined 3% and competition from French sulphur caused a substantial decline in Algeria where shipments only totalled 2,000 tonnes. Increased shipments (9,600 tonnes) to Tunisia, to meet the greater part of additional needs in 1960 more than compensated for these losses.

	1960	1959	Change	%
	000 tonnes		'000 tonnes	
Africa :				
Algeria	2.0	9.2	−7.2	−78.0
Morocco ...	1.8	—	+1.8	—
Canary Islands	4.5	5.0	−0.5	−10.0
Tunisia	25.7	16.1	+9.6	+60.0
South Africa ...	58.9	62.4	−3.5	− 6.0
Total ...	**92.9**	**92.6**	**+0.3**	—

Central and South America. U.S. sulphur continues to hold the bulk of this growing market. Shipments to most individual countries increased, but the overall result was affected by reductions in some of the larger markets. Total shipments in 1960 were 1,213,000 tonnes, some 900 tonnes less than in 1959 and more than double those in 1955. In Argentine the new production from the native deposits of sulphur made itself felt. In Cuba, where politics affected industry and also favoured the entry of Mexican sulphur, shipments declined 5,900 tonnes. Trinidad has for the first time become an importer of brimstone following the start-up of a new fertilizer plant.

Other markets in this area only take small tonnages (under 500 tonnes) and the sulphur is used principally for agricultural purposes.

	1960	1959
	'000 tonnes	
Argentina	21.8	33.3
Brazil	130.9	128.4
Nicaragua	3.9	1.5
Trinidad	11.0	—
Peru	10.2	5.0
Uruguay	5.6	3.3
Venezuela	2.4	3.3
Netherlands Antilles ...	1.5	5.1
Cuba	25.5	31.4

The countries include Costa Rica, Guatemala, Jamaica, Honduras, Colombia and Dominica.

MEXICO

Brimstone exports in 1960 rose 143,000 tonnes (13.8%) to 1,189,590 tonnes, the highest on record since Mexico began exporting in 1955. From the start Mexican Frasch sulphur production was directed primarily to export markets and even to-day, with Mexican domestic requirements three times as great as four years ago, exports account for about 85% of production. Export shipments are wholly met by Pan American Sulphur Company and Gulf Sulphur Corporation, the former accounting for approximately 78% of total shipments. The introduction during the past two to three years of filtering and acid treatment has substantially reduced the proportion of off-colour sulphur shipments and, in the case of Pan American Sulphur Company, virtually the entire tonnage shipped to destinations other than the Western Hemisphere is acid-treated bright sulphur. Mexican sulphur to-day is represented in all major marketing areas of the world where it competes primarily with U.S. sulphur, and in Western Europe with French sulphur supplies as well. Mexico's principal market remains the U.S.A., where over one-half of her exports are marketed.

Similar to U.S. Marketing Pattern

In other parts of the world her marketing pattern is similar to that of the U.S. sulphur suppliers in that the bulk is directed to Western Europe and important shipments go to Australia and New Zealand and Africa. As yet Mexican sulphur has not secured a foothold in Canada and because of unfavourable shipping facilities does not account for a significant proportion of the South American trade.

	1960 '000 tonnes	%	1959 '000 tonnes	%
Western Europe ...	292.9	24.6	199.7	19.1
Eastern Europe ...	3.8	0.3	2.8	0.3
Near East ...	35.9	3.0	23.9	2.3
Australasia ...	122.0	10.3	60.0	5.7
North America ...	599.4	50.4	637.6	60.9
Asia	32.4	2.7	24.7	2.3
Africa	88.4	7.5	82.5	7.9
Central and South America ...	14.8	1.2	16.5	1.5
Total ...	**1,189.6**	**100.0**	**1,046.8**	**100.0**

North America. In 1960 exports to North America—solely directed to the U.S.A., whereas in 1959 there was a small tonnage to Canada—declined by 38,000 tonnes.

Europe. Shipments to Europe increased by 94,300 tonnes (46.2%); details are as follows :—

	1960 '000 tonnes	1959 '000 tonnes	Change '000 tonnes	%
Austria ...	4.6	9.5	− 4.9	− 52
Belgium ...	69.5	37.1	+32.4	+ 87.0
Finland ...	2.2	—	+ 2.2	—
France ...	62.9	57.1	+ 5.8	+ 10.0
W. Germany	55.9	9.6	+46.3	+ 83.0
U.K.	90.5	72.8	+17.7	+ 24.0
Netherlands .	2.0	6.1	− 4.1	− 67.0
Portugal ...	2.0	—	+ 2.0	—
Sweden ...	—	5.8	− 5.8	−100.0
Switzerland ...	—	1.8	− 1.8	−100.0
Eire	3.2	—	+ 3.2	—
Poland ...	3.8	—	+ 3.8	—
Yugoslavia ...	—	2.8	− 2.8	−100.0
Total ...	**295.7**	**202.5**	**+93.2**	**+ 46.0**

The U.K. remains Mexico's principal market in Europe. Large gains were made in 1960 in Belgium and also in Germany. In France, Mexican sulphur more than maintained its position, but in a number of lesser markets competition, mainly of French sulphur, is reflected by a reduction in shipments.

Australasia. Shipments to Australasia have more than doubled in the year and of the substantially increased total import requirements of the fertilizer industries, Mexico secured about three-quarters.

	1960 '000 tonnes	1959 '000 tonnes
Australia	75.4	38.0
New Zealand	46.6	22.0
Total	**122.0**	**60.0**

Asia and Africa. Represented only in the major African and Asian markets, Mexico benefited from their steadily increasing demand. For the first time a shipment was made to Indonesia. In North Africa, Tunisia took about the same volume of sulphur as in the previous year (21,000 tonnes) but Mexico lost its small Moroccan market. The increase in South Africa's sulphur needs was almost wholly met by Mexican sulphur, increasing by over 7,200 tonnes to 67,663 tonnes.

	1960 '000 tonnes	1959 '000 tonnes
India	31.0	24.7
Indonesia	1.4	—
Israel	35.9	23.9
Morocco	—	1.0
Tunisia	20.7	21.0
S. Africa	67.7	60.4
Total	**156.7**	**131.0**

Central and South America. This market is difficult for the Mexican exporters as shipping facilities from Coatzacoalcos are poor. Shipments in 1960 are based on the expanding economies of these countries and therefore represent new consumption rather than trade gained. Details are as follows :—

	1960	1959
	'000 tonnes	
Argentina	—	13.8
Brazil	8.1	—
Peru	0.8	1.7
Uruguay	1.5	—
Cuba	4.4	—
Total	**14.8**	**15.4**

The loss of the Argentine market is attributable primarily to new domestic production from native ores.

FRANCE

In 1960 exports of sulphur recovered by S.N.P.A. from natural sour gas at Lacq totalled 409,381 tonnes, an increase of 192,000 tonnes (85%) compared with 1959. Exports of French sulphur started in 1958, and in the light of the depressed state of sulphur markets in that year, the advent of substantial exports of French sulphur caused widespread alarm. The strong growth of demand since then, especially in Europe, has enabled French sulphur to enter markets without adversely affecting other major suppliers, although in this period price competition between the U.S., Mexican and French sulphur was fierce.

Because of the freight advantage enjoyed by French sulphur over its competitors' markets in Europe, the Near East and North Africa account for the entire volume of French exports.

Of the total exports of 409,400 tonnes in 1960 over 354,000 tonnes was sold in Europe. Details are as follows :—

	1960	1959
	'000 tonnes	
Austria	28.6	18.6
Belgium	35.6	25.7
Denmark	5.2	1.1
Finland	40.4	18.2
West Germany	46.5	30.1
U.K.	107.3	57.2
Greece	—	0.8
Netherlands	21.6	7.8
Norway	0.2	—
Portugal	4.9	0.6
Spain	10.4	4.7
Sweden	24.4	7.2
Switzerland	23.5	10.7
Poland	3.0	3.9
Yugoslavia	33.0	—
Total	**354.0**	**186.6**

Of the European market in 1960 of little under 1.5 million tonnes—including about 150,000 tonnes imported by France from U.S., Mexico and Italy—French sulphur accounted for 23.9%.

Near East and North Africa. With the exception of Israel, where French sulphur abandoned competition in 1960 due to exceptionally low prices, an increasing proportion of consumers look to France for supplies. In Algeria and Morocco, where in 1960 shipments increased by 17,500 tonnes and 5,000 tonnes respectively, France has become the principal supplier, while deliveries to Tunisia are the first to this important and growing market.

	1960	1959
	'000 tonnes	
Egypt	2.0	—
Iran	5.7	7.4
Israel	—	4.1
Lebanon	1.7	3.1
Saudi Arabia	0.8	—
Algeria	31.6	14.1
Morocco	7.5	2.1
Tunisia	5.3	—
Total	**58.6**	**30.8**

ITALY

In 1960 exports of fused sulphur from Italy totalled 46,700 tonnes, including some delivered to Greece in ground form.

During the past three years Italian sulphur exports have been at the low level of just over 30,000 tonnes, and although results in 1960 were more favourable, the industry's high production costs prevent it from competing on world markets. France, Greece and Yugoslavia remain its only significant markets.

	1960	1959
	'000 tonnes	
Austria	1.0	2.1
France	13.0	11.0
Greece	18.0	—
Portugal	—	0.8
Yugoslavia	6.5	2.6
Czechoslovakia	—	3.0
Cyprus	1.3	—
Egypt	4.6	8.0
Jordan	—	0.2
Ceylon	0.3	—
Morocco	—	3.0
Tunisia	2.0	3.6
Total	**46.7**	**34.3**

NORWAY

Exports in 1960 declined 14,000 tonnes (21.4%) to 51,500 tonnes, the seventh year in succession that exports receded from the record figure of 99,259 tonnes in 1954. Supplies

originate wholly from Orkla Gruber S.A., who recover sulphur in conjunction with copper matte production based on pyrite smelting. Low copper and sulphur prices have reduced the company's profitability and contributed to reduced output and sales. Nearly all the shipments are directed to Finland and Sweden and only occasional small tonnages are shipped to other European destinations.

	1960	1959
	'000 tonnes	
Finland	13.0	21.4
Spain	—	5.0
Sweden	38.0	38.8
Others	0.5	0.2
Total	**51.5**	**65.5**

CANADA

Exports wholly directed to the North-West and Western United States increased more than fivefold in 1960 to 129,763 tonnes.

MARKETS

The rapid growth of world brimstone trade in the past 10 years has been due primarily to strong expansion of sulphur needs in the industrialised countries of the world. Of the increase in the volume of shipments of just under 2 million tonnes it is estimated that 83% is represented by increased demand in Europe, North America and Australasia. Exports to these marketing areas in 1960 totalled over 2.9 million tonnes, and if the small number of more industrialised countries in other parts of the world, notably Brazil, India, Israel and the Union of South Africa is included, this total rises to over 3¼ million tonnes or 90% of world trade.

Mexico as Major Supplier

Perhaps the strongest boost to the actual volume of external trade in sulphur has been the emergence of Mexico as a major supplier which rapidly established strong outlets on the U.S. East Coast and in Florida. The U.S.A. thus became once more—after an interval of nearly one-half century—a substantial brimstone importer and to-day importing about 600,000 tonnes from Mexico as well as nearly 130,000 tonnes from Canada, the U.S.A. is the world's largest importer of brimstone.

Although the expansion of demand by importing countries has been impressive, it has been adversely influenced by the growing volume of indigenous supplies of recovered sulphur, mostly from oil refineries, which have reduced net import requirements. It is estimated that outside the U.S.A. the average annual increase of brimstone capacity based on recovery of industrial gases is about 40,000 tonnes a year.

Competition

The dominant feature of world sulphur trade in the three years to the end of 1960 has been the intense competition between Sulexco and the Mexican Frasch suppliers, both of whom competed strongly with French sulphur after its entry into markets from 1958 onwards. The efforts of these producers of securing as large a possible tonnage resulted in progressive reductions of delivered prices which were particularly pronounced in the markets showing the largest growth factor, notably Western Europe, India, Israel and, to a lesser extent, Australia and South Africa.

EUROPE

Europe represents the largest single market for brimstone and, excluding exports to Communist countries, shipments to Europe in 1960 rose to a record level of 1.43 million tonnes. The rapid increase in brimstone consumption was brought about by the high level of industrial activity, especially in chemical industry, and in particular in fertilizer manufacture.

Demand by Acid Producers

A major contributory factor was the impact of a large number of new brimstone acid plants which had been projected when the world brimstone supply position was seen to be become plentiful, causing brimstone to be chosen as raw material for new acid capacity and in some instances conversion of pyrites roasting plants. These plants started coming on stream from 1959 onwards, notably in the U.K., Low Countries and Western Germany. Another important factor in the growth of demand was the improvements of conditions in the Scandinavian pulp industry.

The following table shows shipments (in thousands of tonnes) by the principal exporters to Western Europe :—

Shipments by Principal Exporters

	U.S.		MEXICO		FRANCE		ITALY		NORWAY		TOTAL	
	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959
Austria	7.1	10.2	4.6	9.5	28.6	18.6	1.0	2.1	—	—	**41.2**	**40.4**
Belgium	69.0	54.5	69.5	37.1	35.6	25.7	—	—	—	—	**174.2**	**117.3**
Finland	20.4	12.8	2.2	—	40.4	18.2	—	—	13.0	21.4	**76.0**	**52.4**
France	73.4	87.3	62.9	57.1	—	—	13.0	11.0	—	—	**149.3**	**155.4**
W. Germany ...	68.7	87.6	55.9	9.6	46.5	30.1	—	—	—	—	**171.2**	**127.5**
U.K.	314.1	277.7	90.5	72.8	107.3	57.2	—	—	—	—	**507.8**	**407.6**
Netherlands ...	77.4	42.5	2.0	6.1	21.6	7.8	—	—	—	—	**101.1**	**56.3**
Spain	10.0	—	—	—	10.4	4.7	—	—	—	5.0	**20.4**	**9.7**
Sweden	17.5	10.0	—	5.8	24.4	7.2	—	—	38.0	38.8	**79.9**	**61.8**
Switzerland ...	39.1	35.3	—	1.8	23.5	10.7	—	—	—	—	**62.6**	**47.8**
Others	7.0	1.0	2.0	—	10.4	2.5	18.0	0.8	0.5	0.2	—	—
Total ...	**703.6**	**618.8**	**292.9**	**199.7**	**348.6**	**182.8**	**32.0**	**13.9**	**51.5**	**65.5**	**1,428.7**	**1,080.7**

Exports to Eastern Europe in 1960 totalled 54,700 tonnes, an increase of 6,800 tonnes, as the result of larger shipments to Poland (19,300 tonnes) and Yugoslavia (9,500 tonnes). Czechoslovakia (25,800 tonnes) is the largest market. About 70% is shipped by Sulexco, and the balance by Italy, France and Mexico.

From the producers' viewpoint it is fortunate that this rapid rise in consumption in Western Europe took place in 1960 and so readily absorbed the large export surplus of the new sulphur production from France; the rise in sulphur consumption in Europe had been unprecedented and although French sulphur has gained the largest share (48%) of the total increase of 348,000 tonnes both the Mexican and the U.S. suppliers were able to increase their deliveries to Western Europe by 46.2% and 13.8% respectively.

U.K. Second Largest Importer

The U.K., the largest brimstone market in Europe, is, next to the U.S.A., the largest brimstone importer in the world. Belgium, Western Germany and the Netherlands have increased their brimstone imports at a fast rate, reflecting the increasing number of brimstone acid plants. Among the smaller brimstone consumers, the level of shipments to Spain and Portugal increased as indigenous brimstone supplies are inadequate to meet demand, which in Spain is essentially confined to non-acid uses, whereas in Portugal an increasing volume of acid sulphur is consumed. In both countries French sulphur enjoys the advantage of proximity to these markets, although in Spain U.S. sulphur maintains a part of the market largely by virtue of company connections.

Broadly, U.S. supplies have predominated in the U.K. They rose in Belgium, Finland, Sweden and Switzerland and lost ground in Austria and France. Mexico has improved its position in Belgium, France and Germany, and for the first time has made shipments to Finland, Portugal and Eire. French sulphur increased its share of all markets but does not so far hold a dominant position in any one market. Of the 1960 exports to Western Europe, U.S. supplies accounted for 49.2%, those from Mexico for 20.5%, from France 24.4%, and the balance of 5.9% originated in Italy and Norway. In 1959 these respective shares were U.S.A. 57.2%, Mexico 18.5%, France 16.9% and Italy/Norway 7.4%.

AUSTRALIA

In 1960 the Australian and New Zealand markets received 356,400 tonnes, of which Sulexco supplied about 66% and Mexico about 34%.

The steep rise in demand was occasioned in part by the adjustment of domestic stocks which appear to have taken place, especially in New Zealand, in 1959, but actual brimstone consumption of the large fertilizer producers of Australia and New Zealand also increased to record levels.

In New Zealand sulphuric acid is produced exclusively from brimstone and in Australia, where stimulus by Government subsidy introduced in the mid-fifties had boosted the use of indigenous raw materials such as pyrites and smelter gas to about 50% of total sulphur needs, new demand is predominantly in the form of brimstone. In 1960 shipments to the two markets rose by 32% and Mexico supplied about 74% of the additional requirements.

Shipments to Near East and Asia
'000 tonnes

	U.S.		MEXICO		FRANCE		ITALY		TOTAL	
NEAR EAST	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**
Cyprus	—	—	—	—	—	—	1.3	—	1.3	—
Egypt	5.1	—	—	—	2.0	—	4.6	8.0	11.8	8.0
Iran	2.0	2.3	—	—	5.7	7.4	—	—	7.7	9.7
Israel	20.3	25.5	35.9	23.9	—	4.1	—	—	56.2	53.5
Lebanon	—	1.0	—	—	1.7	3.1	—	—	1.7	4.1
Saudi Arabia ...	1.2	1.6	—	—	0.8	—	—	—	2.0	1.6
ASIA										
India	144.2	126.7	31.0	24.7	—	—	—	—	175.2	151.4
Indonesia ...	3.2	7.8	1.4	—	—	—	—	—	4.6	7.8
Taiwan	12.6	4.2	—	—	—	—	—	—	12.6	4.2
Pakistan	2.2	2.4	—	—	—	—	—	—	2.2	2.4
Others	2.4	2.5	—	—	—	—	0.3	—	—	—
Total	**192.4**	**174.6**	**67.4**	**47.6**	**10.2**	**14.5**	**6.2**	**8.0**	**278.1**	**245.8**

NEAR EAST AND ASIA

The largest centres of consumption are Egypt, India, Iran, Israel and Taiwan, and they account for 94% of shipments to this area. The Near East is a competitive marketing area and in addition to the three main exporters—U.S., Mexico and France—some competition is offered by Italy. The largest market in the Near East is Israel, supplied by U.S. and Mexican sulphur. Of her total imports in 1960 of 56,200 tonnes, Mexico accounted for 64%, having increased her share of this market substantially. The growth of the Egyptian market is short lived from the viewpoint of sulphur exporters.

India is by far the largest importer in Asia; and the expansion in 1960 of shipments to this market by 16% to 175,000 tonnes reflects the rapidly growing demand of the sulphuric acid industry, wholly based on brimstone, and also of the expanding industrial uses of brimstone. As the Government's industrial expansion programme—especially of fertilizers—is implemented, India will become one of the world's major markets with import needs expected to rise to 350,000 tonnes by 1965. Exports to Taiwan also expanded strongly in 1960 under the impetus of her growing fertilizer industries.

AFRICA

Brimstone shipments to Africa are as yet directed exclusively to the extreme North of South of this continent. The predominant use is in sulphuric acid manufacture for fertilizers and only Algeria and S. Africa have significant non-acid uses. In 1960 exports to Africa increased 15% to 227,800 tonnes of which 41% was supplied by U.S.A., 39% by Mexico, 19% by France and 1% by Italy.

Of the additional 30,000 tonnes shipped to the African Continent in 1960, 90% was contributed by France wholly as the result of greater deliveries to North Africa where demand increased substantially. French sul-

Shipments to Africa and Central and South America
'000 tonnes

	U.S.		MEXICO		FRANCE		ITALY		TOTAL	
AFRICA	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**	**1960**	**1959**
Algeria	2.0	9.1	—	—	31.7	14.1	—	—	33.7	23.3
Morocco	1.8	—	—	—	7.5	2.1	—	3.0	9.3	6.1
Canary Islands ...	4.5	5.0	—	—	—	—	—	—	4.5	5.0
Tunisia	25.7	16.1	20.7	21.0	5.3	—	2.0	3.6	51.7	40.7
South Africa ...	58.9	62.4	67.7	60.4	—	—	—	—	126.6	122.8
Total	**92.9**	**92.6**	**88.4**	**82.5**	**44.5**	**16.2**	**2.0**	**6.6**	**227.8**	**197.9**
C. and S. AMERICA										
Argentine ...	21.8	33.8	—	13.8	—	—	—	—	21.8	47.1
Brazil	130.9	128.4	8.1	—	—	—	—	—	139.0	128.4
Nicaragua ...	3.9	1.5	—	—	—	—	—	—	3.9	1.5
Trinidad	11.0	—	—	—	—	—	—	—	11.0	—
Peru	10.2	5.0	0.8	1.7	—	—	—	—	11.0	6.7
Uruguay	5.6	3.3	1.5	—	—	—	—	—	7.1	3.3
Venezuela ...	2.4	3.3	—	—	—	—	—	—	2.4	3.3
N. Antilles ...	1.5	5.1	—	—	—	—	—	—	1.5	5.1
Cuba	25.5	31.4	4.4	—	—	—	—	—	29.9	31.4
Total	**213.0**	**213.9**	**14.8**	**15.5**	—	—	—	—	**227.9**	**220.5**

phur for the first time entered Tunisia, a rapidly growing market under the impetus of expanding phosphate fertilizer manufacture. South African needs rose because of additional acid capacity being commissioned. New projects in East Africa due on stream after 1962 will start to fill the gap in the present consumption picture on the African Continent.

CENTRAL AND SOUTH AMERICA

Total exports to Central and South America increased only 3% in 1960 to 227,900 tonnes. This is due principally to the decline in import needs of Argentine following the commencement of domestic sulphur production and in part due to reduced demand. Nearly all other countries have increased their consumption and Trinidad has become a major importer for the first time following the completion of a major fertilizer plant at Port of Spain. The markets are predominantly supplied by Sulexco but the Mexican sulphur is beginning to establish itself into some of the markets.

Brazil remains the principal single market which, notwithstanding the projected installation of sulphur recovery plant at oil refineries, can be expected to continue expanding steadily. Of the countries in Western South America which produce brimstone from native sulphur in varying volumes, Peru is already a sizeable importer and the rapid growth of chemical industries in Columbia is likely to result in indigenous brimstone supplies becoming inadequate. In Venezuela and in several Caribbean countries, sulphur demand is increasing; notably Cuba could, if the Freeport Nickel project at Moa Bay were reactivated, become a very large market.

OUTLOOK

The volume of world brimstone trade of 3.62 million tonnes—originating essentially from three main sources of supply, U.S.A., Mexico and France—represents approximately 40% of world brimstone consumption. The 19.6% increase of exports in 1960, representing nearly 600,000 tonnes brimstone, accounted for 87% of the net increase of world brimstone production.

Within the past 10 years world trade in brimstone has nearly doubled and the rapid growth of demand in recent years has permitted the new Mexican and French sulphur producers to enter world markets, without preventing the U.S. from increasing its volume of exports.

Despite the declining share of world trade —under 50%, in contrast to the position up to 1955 when the U.S.A. supplied 80% or more of world exports—the U.S.A. is still the largest exporter and at the same time the world's largest importer of brimstone.

This year, as the result of increased recovered sulphur output in France, her export surplus is expected to increase by about 250,000 tonnes and in 1962 by a further 300,000 tonnes. Although greater demand can be expected to account for some of the additional tonnage, displacement of U.S. and Mexican sulphur in markets where French sulphur is favoured is thought to be inevitable. The exportable surplus of recovered sulphur in Western Canada is likely to grow by 200,000 tonnes this year and in 1962 by 1 million tonnes; its entry into markets such as the Far East and Australasia cannot be long delayed and cannot fail to have severe repercussions on U.S. and Mexican sulphur exports. It is estimated that in 1961 world trade will expand at least 9% to over 3.9 million tonnes although under favourable conditions, especially in N. America, an 11% increase to over 4 million tonnes could be achieved.

Exports from U.S.S.R.

Trade in Communist countries is increasing rapidly following the start of brimstone production in Poland. Exports this year, mainly to Czechoslovakia, are expected to total 40,000 to 50,000 tonnes rising by 1965 to 280,000 tonnes, a small part of which may be marketed in W. Europe. The immediate impact is expected to be a loss of about 50,000 tonnes a year exports affecting mainly Sulexco markets. Exports of U.S.S.R. sulphur to the West in 1961, of which over 90,000 tonnes have been offered, are likely to total at least 35,000 tonnes.

In 1960 Europe accounted for 60% of the increase in brimstone exports, North America and Australasia for about 15% each and the rest of the world 10%. As indicated above the rate of increase of world trade in 1961 is not expected to reach that of 1960, largely because

a more modest expansion in European demand is indicated. Fewer new brimstone acid plants are due on stream and a slight decline in the rate of expansion of fertilizer output is likely, although this may be partly compensated by increased emphasis on phosphoric acid and ammonium phosphates, both substantial users of sulphuric acid.

Increased fertilizer activity in Australia and New Zealand and the main consumers in Asia, notably India and Taiwan, and in Africa is expected to continue boosting export trade of brimstone to these destinations. Despite this favourable picture in world markets, the reality—as opposed to the prospect—of the mounting Canadian export surplus from 1961 onwards introduces marketing problems affecting all the established exporters.

Catacarb Process for Acid Gas Removal

Four Features of the Catacarb Process :

- **Less residual carbon dioxide or hydrogen sulphide**
- **Less steam consumption**
- **Reduced size of towers**
- **Reduced capital investment costs**

LOWER costs of acid-gas removal are promised by a new process, known as the Catacarb process. Invented by A. G. Eickmeyer, of Prairie Village, Kansas, the new process is reported to effect a 30 to 40% increase in the removal of carbon dioxide or hydrogen sulphide and to reduce residual carbon dioxide by 33% compared with the hot carbonate process : moreover, it consumes less steam, and by allowing the use of smaller equipment, capital costs are lowered. The essential process feature is the use of a novel non-poisonous type of catalyst, patents for which were pending.

Success of the new process will be gauged from the first commercial tests now in progress in the U.S. Southwest. It is anticipated that it will prove to show advantages over the hot carbonate and monoethanolamine processes, and others, notably those, the efficiency of which is determined by low temperature cooling water.

Investment Costs

For a plant with an input of 100 cu. ft. a day of gas containing 10% hydrogen sulphide, it is estimated that capital costs will amount to $1.9 million for the hot carbonate process, a saving of 25% with a 5% H_2S content. A plant of similar capacity designed to treat a gas stream by the amine process would cost some $1.5 million, compared with only $1.2 million if based on the new Catacarb process.

The Process

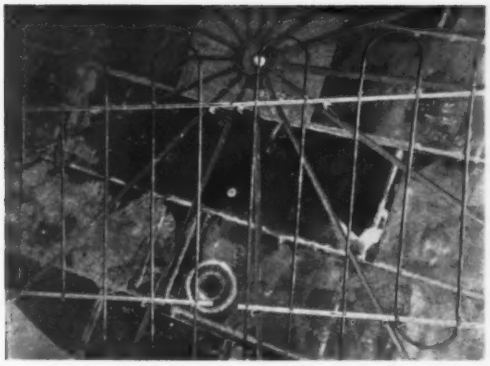
The gas mixture to be cleaned is sent to an absorber column operated at a pressure of about 200 to 500 p.s.i. and is passed upward countercurrently through to the potassium carbonate Catacarb solution in which acid gas has been absorbed. The pregnant solution is then regenerated in a stripping tower operated at 200° to 600°F and after acid gas has been removed from the carbonate solution, this is sent forward for reuse in the absorption cycle.

Eickmeyer claims that the catalyst can be used many times over, as can potassium carbonate. In tightly designed systems, losses of the potassium carbonate total some 500 to 2,000lb. a month. The potassium can be applied to gas streams with any concentration of acid gas — up to date gases containing CO_2 have been treated most frequently — and residual amounts would be as low as 0.05% acid gas. To reach such a low level several repeat stages are necessary, or gas streams are split and treated.

As a result of the added absorption ability, the size of the towers required can be reduced and can be fabricated in carbon steel rather than a stainless steel. Corrosion is reported to be almost negligible by the virtue of a special inhibitor built directly into the Catacarb system. These two factors, together with elimination of a heat exchange for the circulating absorbent solution, help to reduce investment costs.

F. W. Berk Has Europe's Largest Liquid Sulphur Storage Installation

1,000 ton tank at Stratford works



Heating coils just below the roof of the storage tank

Now in service at the Stratford, London, works of F. W. Berk and Company is Europe's largest sulphur storage tank. The new storage facility of 1,000 tons capacity was designed by the company's engineers.

Its installation has been necessitated by the substantial expansion of liquid sulphur deliveries in the U.K., now totalling some 50,000 tons a year. Serious problems had arisen in that the essentially regular contractual programme of deliveries to sulphur consumers was at variance with the inevitable fluctuation in the level of sulphur recovery at oil refineries, which is wholly determined by day to day changes in feedstocks and petroleum product streams.

Liquid Sulphur Transportation Service

During the past five years Berk has progressively built up a liquid sulphur transportation service supplying high purity sulphur recovered at the major oil refineries to users throughout England. In 1960 the company's fleet of specially designed tankers*—each insulated, equipped with heating coils and capable of carrying up to 15 tons molten sulphur, a limit imposed by Ministry of Transport regulations — supplied approximately 50,000 tons liquid sulphur almost exclusively to sulphuric acid manufacturers.

As U.K. agent for non-acid sulphur of the Sulphur Export Corporation, and before the formation of the latter, of the Freeport Sulphur Company, Berk has always carried a sizeable stockpile of solid sulphur. For the past four years this has been housed under cover in a functional building giving ready access on the one side to a quay on the Channelsea River, a tributary of the River Lea, at which barges carrying sulphur from ocean going vessels in London Docks discharge, and on the other to a lorry loading bay and a sulphur melter and 80-ton liquid sulphur storage pit serving the company's sulphuric acid plant.

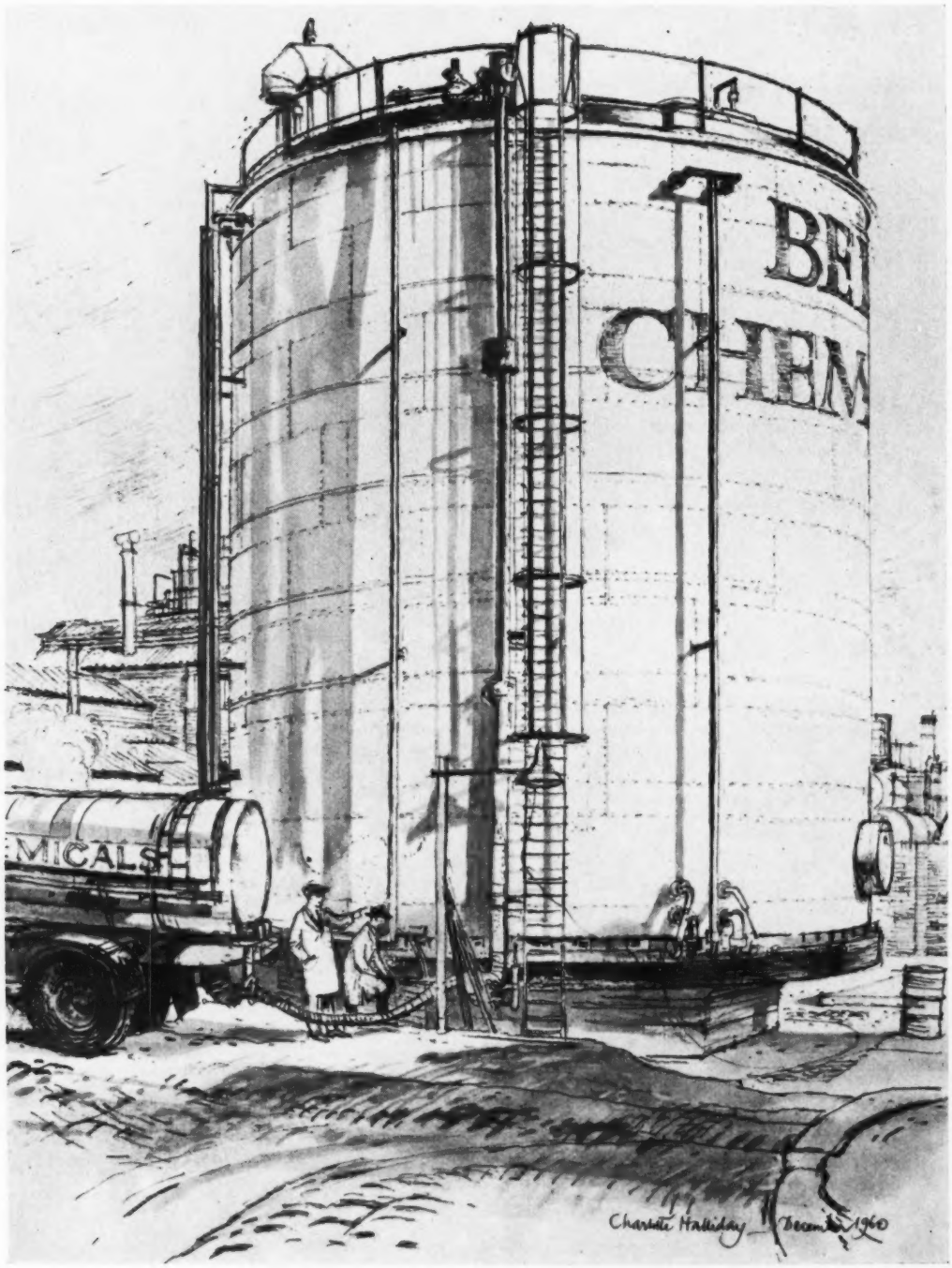
Tank Construction

The new tank is 30 feet high and has a diameter of 30 feet, built of mild steel sheet and butt-welded internally and externally. It stands on a reinforced concrete platform which, because of the unstable subsoil, is supported by six 200-ft. concrete piles. The tank is insulated with calcium silicate blocks at the top, bottom and sides and has an outer cladding of aluminium sheet at the sides and top. The temperature of sulphur in the tank is maintained at 260 to 300°F by two bottom rows of 2-inch diameter steam coils in quadrant sections. A roof coil of $\frac{3}{4}$-inch steam pipe is installed to prevent condensation which would create corrosive acidic conditions and effluent problems through excessive concentration of H_2S in the vent pipe.

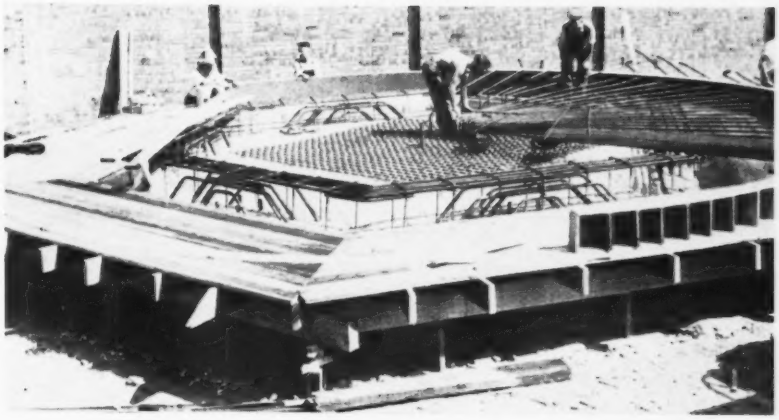
Remote-control Level Indicator

Steam for the heating coils is supplied by the works boiler plant at up to 100 p.s.i. pressure. The tank is equipped with a Kelvin and Hughes remote-control level indicator (pneumicator) calibrated to read accurately within 10 tons. A steam-jacketed submerged feedpipe descending from the roof of the tank to ground level receives the flexible pipe carried by the road tankers through which sulphur is

* On contract hire from Harold Wood and Sons Limited, Heckmondwike, Yorks.



Artist's impression of Berk's 1,000-ton molten sulphur storage tank



Berk's molten sulphur storage tank under construction showing the heating pipes being placed in position

pumped under pressure to 28 p.s.i. to discharge their load into storage.

Future Possibilities

The new liquid storage tank was brought into use in November 1960 and has already proved its worth in providing greater flexibility and above all an assurance of an even flow of supplies. The rate of sulphur recovery at oil refineries is increasing steadily and with it the volume of liquid sulphur handled by Berk. The value of the service to sulphur consumers and the merit of receiving sulphur in liquid form in line with day to day needs are evident from the demand which continues to exceed available supplies. The experience which the company is gaining in this field may prove valuable if at some future date liquid sulphur transportation by ocean-going vessel proves to be economical under U.K. conditions and leads to a major proportion of U.K. sulphur imports being handled and stored in liquid form.

Two-Stage Bisulphite Process Produces High-quality Cellulose from Beech Wood

TWO PULP MILLS—one in Finland, Rauma-Repola OY, and one in Sweden, Moöch Domsjö AB—are using a two-stage process for the production of viscose from coniferous woods, but have not as yet revealed any details about their processes. At Bratislava, Czechoslovakia, however, a procedure for boiling beech wood in two stages to obtain viscose pulp is being developed in the Research Institute for Paper and Cellulose.

Chips of fresh, debarked beech wood, in the first stage, are boiled with sodium bisulphite to the required viscosity. A portion of the macerate is withdrawn and sodium carbonate solution is added to give a pH of 7.5 to 8. In the second stage the pulp is boiled at a high temperature for 1½ to 2 hours. To date, the procedure has been tested in the laboratory in pressure flasks of 750 ml. It produces a 39 to 40% yield of cellulose containing 94.5% *d*-cellulose; if the yield is kept slightly lower—at 38 to 38.5%—the content of *d*-cellulose increases to 96%. Viscosity is in the range of 20 to 40 cps.

It is claimed that the cellulose produced is of exceptional whiteness, an important factor when starting from beech wood. Pilot-plant work based on the data obtained from the laboratory investigations is now being undertaken. Test-runs indicate the possibility of manufacturing high-quality rayon pulp from fresh beech wood.

If the process proves suitable for commercial use, it would enable an excellent cellulose to be produced from inferior beech wood. It would also enable considerable savings in chemicals to be made, particularly in bleaching, compared with the sulphate method.

Expanding Demand for Sulphur in All Forms

WORLD PRICES of brimstone remain firm and with few exceptions current world-wide sales outside North America by U.S. and Mexican producers result in f.o.b. prices equivalent to $23.50 per ton for bright sulphur. Some of the competitive pressure evident in past years has eased mainly as a result of the producers' reluctance to force sales in markets where competitors have clear freight advantages. The present trend points to an endeavour on the part of producers to raise delivered prices of bright sulphur to a level corresponding to the posted price of $25 per ton f.a.s. U.S. Gulf ports. At the current transatlantic sulphur freight rates for large—14,000 to 18,000-ton vessels—of around $4 which appear to be readily available, the impact on delivered prices would not appear to be onerous in most European markets, but consumers' acquiescence in the establishment of such firmer prices would, not unreasonably, be accompanied by a demand for an assurance of stability of delivered prices by placing much of the risk of fluctuating ocean freights on the producers.

Pyrites Prices Competition

A major factor in the movement of brimstone prices in W. Europe is that of pyrites. Despite the slight decline in residues values their present level, based on Spanish crude pyrites prices of 60s. per tonne f.o.b. Huelva, enables pyrites roasters who have good access to seaports and residues plants to purchase the sulphur content of pyrites at about 45% to 50% of the cost of brimstone, which, even allowing for higher operating and capital costs of conversion, makes pyrites clearly the cheaper sulphurous raw material. Views among European pyrites producers appear to be divided whether the industry would benefit more from higher revenue at the present balance of supply or from increased sales at current or possibly even lower prices.

Sulphur demand in all forms throughout the world continues to expand. In 1960 Free World consumption increased by about 5.8% and consumption of brimstone by about 7.8%.

Increase in World Sulphur Trade

The outstanding feature in brimstone consumption was the spectacular increase in world trade of 19.8% to 3.62 million tonnes, representing about 40 % of world consumption. Sulphuric acid production in 1960 reached a new peak of 50.5 million tonnes (100% H_2SO_4) following a 5.2% growth in 1960 in the Free World to 41 million tonnes and an increase of 10.5% in Communist countries to 9.5 million tonnes. In recent months world-wide sulphur demand has increased at a rate slightly lower than last year's, although W. Europe continues to show a high rate of growth. The level of Frasch sulphur production in the U.S. and in Mexico remains unchanged at about 6.1 million tonnes per annum but recovered sulphur output in France and in Canada is expanding. These two sources are expected to yield in 1961 about 1.7 million tonnes brimstone. The additional French output of about 250,000 tonnes is likely to be absorbed readily in the large European market and by the necessary build-up of commercial stocks, and its disposal is unlikely to cause a significant reduction of U.S. or Mexican exports to this area. Exports from Canada, however, even at a level corresponding to current output, whether to overseas markets or to the U.S.A., cannot fail to affect adversely the level of sales of U.S. and also of the Mexican Frisch sulphur suppliers. The mounting level of the Canadian export surplus is becoming the concern of all major producers.

PRICES

Frasch Sulphur

U.S.A. Posted prices of U.S. Frasch sulphur producers' remain at $25 per ton f.a.s. U.S. Gulf ports for bright sulphur; discounts of $1 per ton apply in the case of off-colour sulphur deliveries of $1.50 for delivery f.o.r. *ex* mine. No special rates are being applied to

the mounting volume of deliveries of molten sulphur, any savings—ranging up to ¢90 per ton—benefiting the consuming. Posted prices still only apply in a small number of protected marketing areas and the bulk of domestic and export sales are based on delivered prices embodying freight contributions or other discounts of up to $3.50 per ton. The bulk of U.S. Frasch sulphur sold in the home market appears to be priced at an f.o.b. equivalent of about $22 to $23 per ton for bright sulphur, although some new business is reported to be based on $23 to $24. One producer reports that by July all his contracts are to be based on new prices.

In Florida (Tampa area) delivered prices range from $25 to $27, in the North Central States and the Great Lakes area $26 to $27 and along the Atlantic seaboard in the range of $26.50.

Mexico. Posted prices of $23.50 per ton f.o.b. Coatzacoalcos for bright sulphur—$22.50 per ton for off-colour material—are applied to new business, but most existing engagements of two exporting companies result in lower f.o.b. equivalents. Gulf Sulphur Corporation reports for 1960 an average gross return of $20.11 per ton.

Export Prices

In W. Europe delivered prices of U.S. and Mexican Frasch sulphur and of French recovered sulphur range from $26.50 to $31 per ton c. and f. In W. Germany consumers failed to benefit from the recent devaluation of the Deutsch Mark as brimstone imports are not purchased in foreign currency. Russian sulphur sold in Sweden at a price resulting in substantially lower landed costs than those of U.S. or French sulphur at S.Kr. 158 per tonne c. and f. Similarly low-priced Russian sulphur is offered in most W. European countries by Stemmler-Imex Mij of Hilversum and associates who negotiated a bulk contract with Sojuspromexport.

Delivered prices in India have risen under pressure of higher freight charges and are currently reported at $31 to $32 c. and f. Bombay and $32 to $33 c. and f. Calcutta. In South America delivered prices of U.S. and Mexican sulphur are reported at $30 to $31 c. and f.

Recovered Sulphur

In W. Europe prices of most indigenous sulphur supplies are firmer, reflecting the tendency in imported supplies. In W. Germany prices in the Ruhr and at Hamburg, of brimstone recovered at oil refineries and by Ruhrgas, range from DM118 to DM125 plus turnover tax, handling and service charges.

Recovered sulphur in Belgium is sold at B.Frs. 1,300 to 1,350 and in Holland 99 to 104. In France delivered prices to domestic consumers range from NF. 130 to 140 per tonne. In Sweden recovered brimstone supplies of Svenska Skifferolje are sold at S.Kr. 158 to 160 and imported Orkla sulphur is delivered at S.Kr. 158 per tonne.

Recovered sulphur in W. Canada remains nominally based on $23.50 per short ton *ex* plant. Delivered prices embodying freight charges vary considerably throughout the large area of the market which extends over Alberta, British Columbia and U.S. North-Western and Pacific States. In 1959 the average value of sulphur production was reported at $19.35 per short ton. Preliminary estimates for 1960 indicate that the average may well be as much as $2 lower. According to the annual report for 1960 of Jefferson Lake Petrochemicals of Canada Ltd. the average gross sales revenue—less freight and handling charges—was $14.90 per short ton, $2.07 less than in 1959.

Pyrites

European pyrites prices are essentially based on the price of Rio Tinto and Tharsis crude fines pyrites of 60s. per tonne basis 48% f.o.b. Huelva. Other Spanish pyrites are priced correspondingly and Rio Tinto's 'confines' gravity concentrates are quoted at 50s. per tonne f.o.b. Portuguese pyrites are based on 60s. per tonne f.o.b. Setubal and Cypriot and Norwegian pyrites are priced competitively. Average export prices of Cypriot pyrites in 1960 is reported at 55s. 1d. per ton. Following the currency revaluation in W. Germany and Holland pyrites consumers in these markets are believed to have reduced purchase costs by 5%, thereby widening the gap between the cost

of sulphur in pyrites and brimstone, in favour of the former.

The pyrites price to be established for the second half of 1961 will exert a strong influence on the trend of brimstone prices in W. Europe, especially in the Low Countries.

The Western Australian Government has agreed to a temporary extension of three months to 31 March 1961 of the rail freight subsidy on pyrites delivered from Kalgoorlie and Norseman Mines. In addition to the subsidy of £A1 5s. 2d. per ton pyrites this production of about 60,000 t.p.a. qualifies for Commonwealth Bounty; total concessions amount to £A7 4s. per ton sulphur contained to enable this material to compete with brimstone imported into W. Australia at about £A15 per ton; these subsidies do not preclude consumers of pyrites from qualifying for the higher Bounty on sulphuric acid produced from indigenous material.

SUPPLY

U.S.A. Production of Frasch sulphur remains restricted to about 400,000 tons per month. Domestic demand has improved in recent weeks and continued high exports of Frasch sulphur has resulted in stockpiles being slightly reduced. At the same time indigenous recovered sulphur supplies now at an annual rate of 800,000 tons, and imports from Mexico and Canada are mounting slowly. Refined sulphur deliveries to the U.S. market are reported to be lower than those of last year, mainly on account of reduced sales of ground and special sulphur to rubbermakers. Other important outlets—sugar refining, food processing, matches—are reported to be unaffected.

The progressive completion of ocean-going sulphur tankers, terminal facilities at mines and distribution points is augmenting the volume of molten sulphur shipped to U.S. industry and by the end of this year it is estimated that 35 to 40% of total brimstone consumption will be in this form.

Mexico. The start of regular production at the Texistipec Dome of Central Minera S.A. adds at present about 2,500 tons per month to Mexican Frasch sulphur supplies which are now about 90,000 t.p.m. Exports in the first quarter of 1961 totalled 250,928 tons.

Iraq. The "discovery" is reported by Russian and Iraqi geologists of large deposits of sulphur in the Makhlat and al'Fattha districts; systematic drilling to determine reserves is in progress. It is believed that the deposits in question are the dome formation at Khijara near Kirkuk, which were examined in 1951 by the Sulphur Exploration Syndicate of London and in respect of which the Texas Gulf Sulphur Company subsequently negotiated with the Iraq Government.

Italy. Fused sulphur output continues to decline; in 1960 production totalled 81,000 tonnes—33.1% less than in 1959—and current output is at a rate of about 6,000 tonnes per month. To meet domestic needs and the small export commitments E.Z.I. is reducing stocks and where necessary filtering lower grade material ("bruni") to meet quality requirements. Current stocks are estimated at about 140,000 tonnes.

Recovered Sulphur

Lacq. In March the level of production and sales rose to over 80,000 tonnes, representing an expansion of daily operating rates by about 500 tonnes. Exports in March totalled 53,761 tonnes, the highest yet recorded in a single month.

Sweden. Output of recovered sulphur from shale oil refining by Svenska Skifferolje A.B. in 1960 totalled 39,000 tonnes, some 4,000 tonnes more than in 1959. Further expansion is expected but the projected construction of new retorts and a second sulphur recovery unit is believed to have been postponed.

Iraq. The 90,000 t.p.a. sulphur recovery project at Kirkuk which was originally engineered by the Ralph M. Parsons Company of Los Angeles, and was to have been built by U.S.S.R. engineers, has now been abandoned following the decision to build a petrochemicals/fertilizer complex at Basrah. The plant will be based on natural gas from Rumaila, where a treatment and sulphur recovery unit is now proposed. The Basrah works will include a sulphuric acid plant with a planned capacity of 20,000 t.p.a. (100%

H_2SO_4), although the apparent sulphuric acid needs of the ammonium sulphate plant are estimated at 87,000 tonnes acid annually.

Taiwan. Under Formosa's third Four-Year economic development plan brimstone production is to be increased to 7,000 t.p.a. by 1964. The current level of output is 3,000 tons p.a. and imports about 12,000 tons.

PYRITES

World production of pyrites, which in 1960 is estimated to have totalled 6.24 million tonnes S content, an increase of 4.5% compared with 1959, continues to expand especially in Europe and Japan. In Spain the current level of output is reported to be in excess of 180,000 tonnes per month, about 4% higher than last year's.

Preliminary details—based on official returns—of the eight principal European pyrites importing countries indicate that in 1960 their imports rose 27% to 3.85 million tonnes pyrites. Only the Netherlands imported less (—861 tonnes) than in 1959; the largest increase is reported from W. Germany where imports of 1,718,999 tonnes were over 400,000 tonnes (28.8%) greater than in 1959 and substantially in excess of anticipated consumption. The largest proportional increase occurred in Belgium where imports of 429,704 tonnes pyrites exceeded the previous year's level by 59% or nearly 160,000 tonnes.

Exports from Cyprus in 1960 totalled 1,064,343 tons, 11% more than in 1959, including 815,412 tons iron pyrites.

Italy. Production at Niccioleta, one of Soc. Montecatini's major pyrites mines in the Maremma, is to be expanded to provide supplies for an integrated 1,000 t.p.d. (100% H_2SO_4) sulphuric acid plant to be built at Follonica by June 1962. Crude ore of about 35% will be beneficiated to 48%; after roasting, the residue of customary high quality will be supplied direct to blast furnaces at an annual rate of 170,000 tonnes.

Yugoslavia. The flow sheet of a new lead-zinc ore treatment plant at Gracanica will include provision for the recovery of flotation pyrites. Due on stream in 1965, output is planned at 27,000 t.p.a. pyrites.

Brazil. Production in the State of Minas Gerais is to be expanded if agreement is reached between the State Government and a W. German consortium planning to build a major sulphuric acid plant based on local pyrites. Of Brazil's 32 acid plants only three are at present based on local pyrites, of which the largest is the 300 t.p.d. (100% H_2SO_4) plant of S. A. Mineros and Acidos controlled by Farbenfabriken Bayer AG.

Taiwan is to raise pyrites production by 1964 to 57,000 t.p.a., approximately double the current output.

Freights

Vessels Available to U.S.A. At Low Rates

THERE are no signs so far of any serious attempt by sulphur and pyrites buyers to stockpile those materials or to seek forward freight cover over the remainder of this year. January and February chartering has tailed off and freights, where changed, are lower, in striking contrast to the huge demand for tonnage in other quarters and the sharp upsurge of freights in the longer trades.

Movements of pyrites from Cyprus, Spain and Portugal to conventional customers in North-West Europe and Great Britain have, as usual, provided the bulk of the traffic in this sector. Belgian charterers, in particular, have recently secured tonnage at extremely low freights, within a shilling or two of the lowest established during the recent slump, including as little as 22s. 9d. from Setubal and 23s .3d. a ton from Huelva on the customary charter party terms. One ship accepted 23s. 6d. a ton

on net terms from Finneid (Norway) to Rotterdam and for discharging in Ghent a 1,700-tonner accepted 28s. 0d. from La Laja. Tonnage continues to be sought for 50,000 tons of pyrites from Carthagena to Alexandria, for shipment over this year, in combination with 125,000 tons of superphosphates, freight indications being around 21s. 0d. a ton f.i.o. Plentiful return traffic is available from Alexandria in the form of burnt ore cargoes, although the freight to Rotterdam, 24s. 0d. a ton, is far from attractive. Italy, Spain and North France also offer a large selection of residues cargoes for Germany and Holland, but less usual is a requirement from Sluiskil to Newcastle for 60,000 tons to be shipped in coaster vessels.

Freight Rise in Mediterranean ?

A significant feature of all recent business from the Mediterranean area is the fact that most of the ships taken are well below the average size for the trade, ranging from 1,500 tons to 3,500 tons. These ships are normally too small to range further afield and their present availability was without doubt due to the fact that their only other major outlet, the Baltic Sea, remains closed by the winter ice. The absence of the bigger vessels of 8,000 to 12,000 tons may well be because they can now earn much more in the longer trades, especially since the extent of the Chinese famine became known. If they do not come back to the shorter trades in the summer when the little ships are back up North, there seems a likelihood of a big rise in Mediterranean freights.

News of sulphur charterings from Bayonne is slight, although, from reports from the loading area, considerable quantities of Lacq continue to be moved to the United Kingdom, Belgium, Holland and Germany. Recent shipments include 2,600 tons from Bayonne to Raumo and 2,000 tons for Kotka. A drop in freights for coasters in the 500 to 1,200 tons range over the last month favour the French shippers.

Low Freights for Sulexco

From the United States Gulf Sulexco continue to find vessels at low freights; the last at equivalent to $3.95 a ton on f.i.o. terms, which is 50¢ below the current rate for wheat on a similar run to Antwerp/Hamburg ports. Part of the explanation is that the Americans can use bulk-carriers in the 16/20,000 tons group which are too big for almost all the Eastern trades for discharging in the United Kingdom, but are too small to compete on economic terms with the 40,000-ton tankers which now dominate the grain import trade of the Continent. They may still be at a discount if, as many believe, later this year freights for tramp ships up to 12,000 tons reach, if not boom rates, very profitable ones for their operators.

The following freight statistics are based on known charterings, save where recent reports are lacking. In such cases " notional " figures, calculated on freights paid for other commodities moving in the same direction, are inserted.

EXPORTING AREA	DESTINATION	FREIGHTS PER LONG TON (Month of March)		
		1961	1960	1959
U.S. Gulf/Mexico	United Kingdom[1]	48s. 0d.	52s. 0d.	47s. 6d.
,, ,, ,,	N.W. Europe[2]	$4.85	$4.50	$4.50
,, ,, ,,	India[3]	$11.00	$9.50	$9.0
,, ,, ,,	Australasia[3]	$12.85	$12.75	$10.00
,, ,, ,,	Brazil[4]	$5.50	$5.50	$4.35
Bayonne	N.W. Europe[4]	18s. 0d.	16s. 6d.	14s. 0d
,,	United Kingdom[1]	28s. 6d.	29s. 6d.	23s. 3d.
Huelva	Antwerp[5]	23s. 3d.	24s. 0d.	21s. 9d.
Cyprus	Rotterdam[5]	27s. 0d.	28s. 0d.	25s. 0d.
,,	United Kingdom[6]	38s. 6d.	40s. 0d.	38s. 0d.

KEY TO CHARTERING CONDITIONS:—

1 Cargo f.o.b. ship to pay current rate for discharging
2 Shipowner to pay 50 cents ton for loading and 40 cents discharge
3 Ship pays 50 cents ton loading and current rate discharging
4 Cargo f.i.o. (no charge to ship for loading/discharging)
5 Ship pays 2s. 6d. ton loading and 2s. 6d. ton discharge
6 Ship pays 2s. 6d. ton loading and current rate discharge

1960 Demand for Sulphur and Sulphuric Acid in U.K. Highest on Record

DURING 1960 demand from all sectors of the sulphur and sulphuric acid consuming industries was the highest on record. The overall industrial index of production averaged 120 (1954 = 100) and although overall industrial production in 1960 showed only a modest increase due to the differences in prosperity of the various industrial sectors, most of the major sulphur users increased their activities substantially. Outstanding were the chemical, fertilizer, textile and paper industries and the recessionary trends in durable goods, notably motor cars and refrigerators, did not seriously affect the sulphur industry.

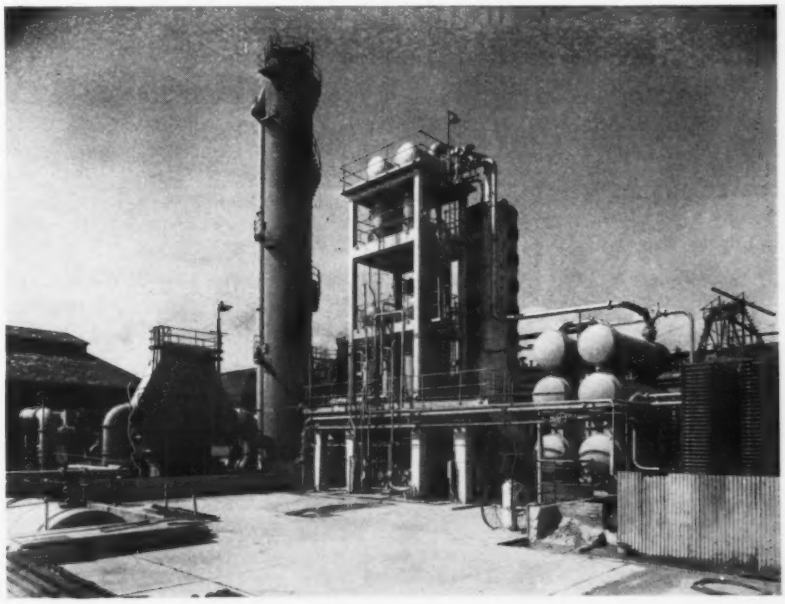
One of the features of the overall industrial activity was the substantial increase in stocks, which rose 10% in 1960, valued at £457 million compared with an increase of 1% (£56 million) in 1959. The amount of work in progress, which had risen by £25 million in 1959, rose by £118 million in 1960; this also added to the growth of demand last year.

Capital expenditure during the year under review showed a fall of 1%, reflecting a decline of 4% for manufacturing industry. It is estimated, however, that iron and steel, textiles and clothing and motor vehicle groups of industries between them accounted for about 70% of the increase in manufacturing capital expenditure in the year.

Consumption of Sulphur

In the year under review consumption of sulphur in all forms amounted to 1,251,000 tons, an increase of 87,000 tons (7%) over 1959. Indigenous supplies accounted for 78.5% of total acid.

Indigenous production of sulphur in all forms rose to a record figure of 606,000 tons, an increase of 2.2% over the previous year. Imports of sulphur in pyrites and filter cake and of brimstone totalled 635,000 tons S content, valued at £6.75 million.



South-Eastern Gas Board's CS_2 removal plant at Portslade engineered and constructed by R. and J. Dempster Limited. Sulphur is removed by oil-washing and vacuum distillation. The installation has a capacity of 21 million cu. ft. of gas per day and ensures 90% CS_2 removal

PRODUCTION

Anhydrite

Production of anhydrite in 1960 totalled 1.7 million tons.

At Imperial Chemical Industries' Casebourne Works' anhydrite mine production is estimated to have been 1.25 million tons. The mine is now using advanced mining machinery to improve production and reduce costs.

Recovered Sulphur

Capacity for recovery of sulphur in the U.K. was not expanded in 1960. Output is estimated at 65,000 tons. In May 1960 the hydrodesulphurizer at Shell Petroleum Company's Shell Haven refinery came into operation. This plant has a capacity of 20 tons of sulphur a day. In due course, when Esso Petroleum Company's Milford Haven refinery is fully operational some 25,000 tons of sulphur a year can be expected to be recovered. Deliveries of recovered sulphur are taken by F. W. Berk and Company Limited, using a fleet of specially-built tankers. The sulphur is delivered molten to customers and, if not taken direct from the refinery to the specific destination, is now being stored in a 1,000-ton molten sulphur storage tank, Europe's largest such storage facility at Berk's Stratford works. (See Page 11).

Smelter Gas

A small by-product sulphuric acid output from zinc concentrates roasting increased 3% in 1960 the entire output originating from the smelters of Imperial Smelting Company Limited at Avonmouth and Swansea, which produced 161,900 tons (100% H_2SO_4), equivalent to 52,900 tons sulphur content. The plants worked within 1% of capacity for most of 1960.

Ferrous Sulphate

Operation started in July 1960 at Swansea of the new Lurgi-type sulphuric acid plant based on ferrous sulphate monohydrate extracted from waste pickle liquor. Some 4,000 to 5,000 tons are estimated to have been converted to sulphuric acid.

IMPORTS

Brimstone

With sulphuric acid production at new peak levels and greater new acid uses of brimstone demand for brimstone also increased. Imports of sulphur rose steeply to 487,076, about 122,000 tons more than in 1959.

The average value per ton of brimstone continued to decline, and was £10 9s. compared with £10 16s. in the previous year.

Imports of sulphur from the U.S. increased by 34,986 tons to 296, 235, an increase of 13%, and those from Mexico by 32% to 89,389 tons. The significant change was the very large imports from France, which rose by 52,537 tons to 101,276 tons, a 108% increase over the previous year. Stocks of imported brimstone are reported to have totalled 53,232 tons at the end of 1960, an increase of about 2,000 tons during the year and representing about seven to eight weeks' consumption.

U.K. Imports of Raw Sulphurous Materials

	1959		1960	
Sulphur	**Tonnage**	**Average Value**	**Tonnage**	**Average Value**
France	48,739	£11 1s.	101,276	£10 12s.
Belgium	20	£27 16s.	174	£18 15s.
U.S.A.	261,279	£10 15s.	296,235	£10 10s.
Netherlands	—		2	£75
Mexico	65,332	£10 8s.	89,389	£10 0s.
Total	**375,370**	**£10 16s.**	**487,076**	**£10 9s.**
Sulphur Waste				
U.S.A.	16,617	£6 11s.	15,459	£7 8s.
Total	**16,617**	**£6 11s.**	**15,459**	**£7 8s.**
Pyrites				
Cyprus	136,864	£4 18s.	210,173	£4 11s.
Canada	26,484	£5 0s.	10,093	£4 2s.
Eire	1,257	£4 2s.	7,155	£3 1s.
Spain	22,710	£5 4s.	21,917	£5 1s.
Italy	—		2	£9 0s.
Sweden	26,457	£4 12s.	25,797	£4 9s.
Total	**213,772**	**£4 15s.**	**275,137**	**£4 11s.**

Sulphur Filter Cake

Imports of sulphur wastes from the U.S. decreased for the first time in several years by 7% to 15,459 tons. The price had, however, risen by 17s. per ton. No filter cake was imported from any other source during the year.

Pyrites

Pyrites imports in 1960 totalled only 275,137 tons and substantial quantitites had to be drawn from users' stocks to meet the heavy demand. At the end of 1960 distributed stocks totalled 132,527 tons—about 20 weeks' consumption. Imports from Cyprus rose significantly by 73,000 tons to the high level of 210,173 tons and its share of the U.K. market increased from 64% in the previous year to 76% in 1960. Pyrites imported from Avoca, Eire, slightly increased (by 2.6%), whereas those from Spain and Sweden declined markedly and those from Canada fell sharply.

Low f.o.b. prices and freight rates helped to keep import costs down and the average value per ton of pyrites, £4 11s. 0d., has continued the downward trend noted during the last few years.

CONSUMPTION

Consumption of sulphurous raw materials reached record levels in both sulphuric acid and "non-acid" sectors of the industry. Total consumption of sulphur in all forms is estimated at 1,251,000 tons.

Sulphuric Acid

Peak production of sulphuric acid resulted in increased consumption of all types of new materials which rose 11% to 949,900 tons S content. The most important was the use of pyrites and spent oxide, which rose substantially, while anhydrite and sulphur in smelter gases increased slightly.

Brimstone

The increased demand for imported brimstone, approximately 50,000 tons (15.2%) greater than in 1959, is primarily the result of new sulphuric acid plants installed in the last two years by Laporte Titanium Limited, British Titan Limited, Fisons Limited, and by Imperial Chemical Industries Limited's subsidiaries, Scottish Agricultural Industries Limited, and Richardson Chemical Manures Limited, Northern Ireland.

Anhydrite

Anhydrite, zinc concentrates and spent oxide were all in good demand. Consumption of anhydrite for acid manufacture, which declined slightly in 1959, was up last year by 1.6% to 760,100 tons.

Spent Oxide

In contrast to the last few years' trend, consumption has risen by 12.8% to 250,200 tons and is a reflection of the boom conditions in the sulphuric acid industry in 1960.

Zinc Concentrates

From this source 332,300 tons of sulphuric acid were produced. In demand were zinc concentrates, which responded again to the better conditions which were noted in 1959. Use of concentrates rose by 3.1% to 197,500 tons. The recovery of 161,900 tons of sulphuric acid represents the equivalent of 52,900 tons sulphur produced at the zinc smelters of National Smelting Corporation at Avonmouth and Swansea.

Pyrites

Use of pyrites has made a striking recovery, and last year was 10.6% higher at 353,000 tons, reflecting the intense activity of the U.K. sulphuric acid as a whole. At this level of use existing capacity was almost fully utilized. Demand has been met predominantly by Cyprus pyrites flotation concentrates to meet the specific needs of flash roasters, which represent the bulk of operating facilities.

Non-acid Sulphur

Consumption of brimstone for non-acid uses is estimated to have risen to 105,000 tons in 1960 as the result of the continued favourable conditions in the man-made fibres industry. Rayon and acetates now account for over three-quarters of all U.K. man-made fibres production. Industrial yarn trade, mainly for tyre-cord, was particularly bright during the first half

of 1960, but was very slack duing the second half of the year. There is, however, mounting competition from the new synthetic fibres.

Sulphur Use Pattern in Non-Acid Sector

'000 tons

	1959	1960*
Carbon Disulphide	52	54
SO_2	15	17
Rubber	10	10
Agriculture	5	6
Ultramarine	4	5
Wood Pulp	3	3
Others	13	14
Total	**102**	**108**

* estimates

Courtaulds Limited has reduced its usage of brimstone for carbon disulphide at Greenfield, N. Wales and Trafford Park, Manchester, but not, it is believed, at its Carrickfergus, N. Ireland, viscose production plant. Some of the reduction in sulphur consumption has been due to the recovery of CS_2 at the new Landmark plant at Greenfield, which has been in operation over 18 months. It is thought, however, that this plant's contribution to CS_2 recovery has not been so notable as has been hoped and that operating difficulties have occurred.

Demand for sulphur by the rubber, bleaching and dyestuffs industries has been high and sulphur dioxide manufacture is expanding.

SULPHURIC ACID

Production

Last year sulphuric acid production rose to the record total of 2,701,374 tons (100% H_2SO_4), an increase of 272,870 tons or 11.24% over 1959. Output from contact plants has risen to a total of 2,262,257 tons and now accounts for 83.8% of total production, compared with 83.5% in the previous year.

Sulphuric acid production from the various new raw materials is shown at top of next column.

	1960 Acid Production 100% H_2SO_4	1960 % of total	1959 % of total
Pyrites	460.1	17	17.2
Spent Oxide	332.3	12.3	12.1
Sulphur	1,289.5	47.8	45.9
Imported	1,103.6	40.9	39.5
Recovered H_2S and filter cake	185.9	6.9	6.4
Zinc Concentrates	161.9	6.0	6.6
Anhydrite	457.5	16.9	18.2
Total '000 tons	**2,701.3**	**100%**	**100%**

Installed capacity of chamber and tower plants has further declined and in 1960 totalled 550,700 tons, of which only 79.7% was utilized (70% in 1959). Installed capacity of contact plants, however, has risen to just under 2.5 million tons. Of the total capacity available 90.7% was utilized (80.4% in 1959).

Consumption

In 1960 sulphuric acid consumption totalled 2,738,150 tons (100% H_2SO_4), an increase of 272,374 tons (11%) compared with the previous year. In every U.K. acid consuming industry there was an improved level of activity, and acid usage expanded.

Consumption in the principal consumer groups was as follows :—

Sulphuric Acid Consumption

	1960	%	1959	%
	Thousand Tons			
Fertilizers	915.5	33.4	840.5	34.3
Superphosphates	621.4	22.7	568.4	23.2
Ammonium sulphate	294.1	10.7	272.1	11.1
Titanium dioxide	467.7	17.1	401.6	16.4
Chemicals	280.1	10.2	271.2	11.0
Rayon and Transparent paper	278.1	10.2	259.5	10.6
Metallurgy	142.4	5.2	125.6	5.1
Soap, glycerine and detergents	124.8	4.6	118.3	4.8
Oil refineries	77.1	2.8	64.8	2.6
Dyes	104.5	3.8	98.6	4.0
Plastics	65.3	2.4	49.0	2.0
Miscellaneous	282.6	10.3	226.7	9.2
Total	**2,738.1**	**.00%**	**2,455.8**	**100%**

Raw Materials for Acid Production

	1960	1959	% Change	1958	1955	1955	% Change
Imported	377,700	327,800	15.2	277,600	248,600	227,500	95.0
Recovered H_2S and Filter	65,600	55,700	19.5	44,800	24,100	—	—
Pyrites	353,000	319,300	10.6	327,700	457,700	217,500	62.5
Spent Oxide	250,200	221,800	12.8	242,700	260,900	231,300	8.2
Anhydrite	760,100	748,000	1.6	749,000	382,200	176,000	320.0
Zinc	197,500	191,600	3.1	152,200	200,400	165,100	9.6
S Content	949,900	856,200	10.9	797,500	755,700	528,400	80.0

The major changes in acid consumption are of interest. Compared with 1959, they are as follows :—

	'00 tons Actual Consumption	Change tons	Change %
Iron pickling ...	137.4	+17.1	+12.4
Oil refining ...	77.1	+12.3	−15.9
Plastics	65.3	+16.3	+25.0
Rayon	278.1	+18.6	+ 6.7
Ammonium sulphate	294.1	+22.0	+ 7.5
Superphosphate ...	624.5	+53.0	+ 8.5
Titanium dioxide	467.8	+66.1	+14.1

With steel in strong demand, last year the amount of sulphuric acid required for pickling increased. Plastics production was intensive last year and this is reflected in the 25% increase in acid consumption.

Acid required in titanium dioxide manufacture has been increasing steadily for the past several years, and last year rose by 14.1%. Oil refining, too, has required more sulphuric acid as has superphosphates manufacture.

Ammonium sulphate production rose by 7.45%, thereby reversing the decline noted in 1959 (–7.5%).

A striking increase in acid consumption for agricultural purposes (+47.5%), occurred in 1960, due to the use of sulphuric acid instead of arsenic for destroying potato haulms. Bromine production, which has been increased by Associated Ethyl Company, required increased acid needs—32.6%. A notable feature of acid consumption changes is the increased usage for superphosphates represented by increased phosphoric acid production mainly for triple superphosphate manufacture.

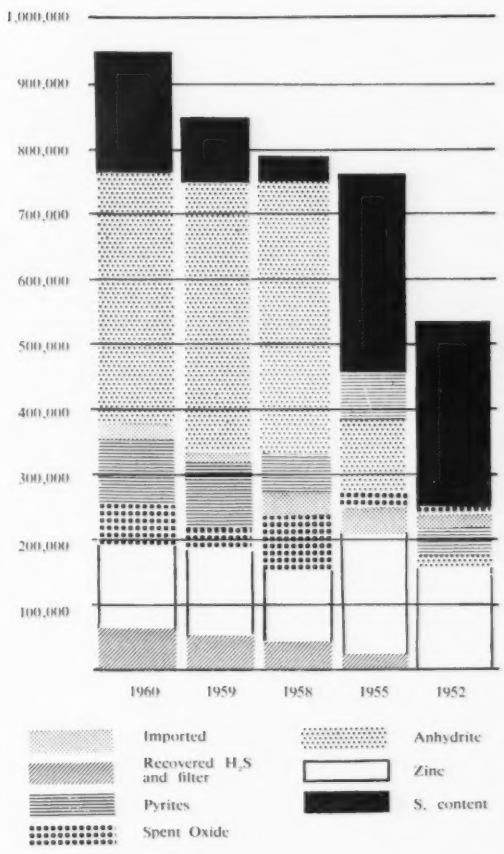
Acid Consumption Changes

	% Change
Agricultural purposes	+47.5
Explosives	−27.7
Oils	+17.2
Paper	+23.1
Phosphates	+36.5
Copper sulphate	+19

OUTLOOK

Demand for consumer goods in the early part of 1960 was good, but 1960 as a whole saw the end of a short-lived boom and by the end of the year industrial production had fallen off to some extent. It is considered that for the present a rise in output of some 2½%—and perhaps 4% in industrial production—is probable in 1961. Despite the general slowing down of the economy in the latter part of 1960, the sulphuric acid industry's production remained at record levels, and this trend is expected to be maintained in 1961.

Raw Materials for Acid Production



Despite some recovery, the U.K. car industry, indirectly a vital consumer of sulphuric acid products, has not regained its 1960 level and is not expected to reach this until the latter half of 1961, and possibly even 1962. The rayon industry, to some extent linked with the car industry, is also in the doldrums, with rayon demand having declined. An indication of the setback in the U.K. man-made fibres industry is provided by the production figures for January this year, which fell below the level of the same month in 1960. Recession

Sulphuric Acid Plants Commissioned in the U.K. in 1960

Company	Type	Site	Contractor	Date
A.C.C. (Associated Chrome Chemicals Limited)	100 tons a day contact plant	Eaglescliffe	P. G. Engineering Limited	Commissioned May 1960
Blythe, William & Company Limited	Modified acid plant using B.A.S.F. fluidized bed roaster	Hapton		Restarted early 1960
British Celanese Limited	Three sulphuric acid concentration units	Spondon	Constructors John Brown Limited	Completed early 1960
British Titan Products Limited	250 tons/day sulphur-burning contact acid plant	Billingham	Chemical Construction (G.B.) Limited	Commissioned early 1960
Sulphuric Acid Plant Projects				
Farmers Company Limited	50 tons/day acid plant	Brigg	Simon Carves Limited	Commissioned March 1961
Laporte Titanium Limited	300 tons/day acid plant	Stallingborough	Simon Carves Limited	Due to be completed 1961
Solway Chemicals Limited	Third anhydrite kiln to increase acid production by 5%	Whitehaven		Due to be completed 1961

in the carpet industry, where rayon was finding a useful outlet, may be largely responsible for the lower output. There has been overstocking in other trades, and a falling off in orders has been expected. Nylon and Terylene fibres are also offering strong competition to rayon producers, and this competition is expected to increase in intensity.

Reduced Demand for Rayon

The reduced demand for rayon, which is a heavy user of sulphur as sulphuric acid or as carbon disulphide, is reflected in the recent decision by Courtaulds Limited to introduce short-time working at its Greenfield plant, the larger of its two rayon staple factories. Similarly, another U.K. rayon producer, British ENKA Limited, a subsidiary of A.K.U., of Holland, reports that during 1960 it traded at a loss. British ENKA produces mainly rayon yarns for tyres, and since 1959 British producers of industrial rayon yards have been compelled by foreign competition to reduce prices of tyre yarns by more than 3d. a lb., while at the same time demand for this product has fallen. Although the situation in tyre-cord is not yet comparable with that in the U.S. the rayon industry is facing continuously mounting competition.

In the steel industry the first two months of this year have been below the peak levels of the last year (average rate of 488,300 tons a weke in February, compared with the weekly average of 500,000 in February 1960). The short fall is almost entirely concentrated in sheet steel and tin plate, where some short time is being worked. Weakness in tin plate is mainly a seasonal matter, but the weakness in sheet steel is rather more serious, reflecting the down-turn in the motor industry and appliances. The situation is complicated by much of last year's heavy imports of sheet steel lying in industry dockyards. A certain amount of cancellations of orders has been reported and there has been a general destocking movement among customers. To keep production going both sheet steel and tin plate are being exported to the Continent at comparatively low prices, and foreign sales have taken up the slack in the home market. The industry is hopeful, however, of fulfilling its forecast production of between 24 million and 25 million tons in the full year.

TiO_2 Production Maintained

The titanium dioxide sector has maintained its progress, and as the second largest consumer of sulphuric acid and brimstone in the U.K., the industry is of major importance. Demand by the paint industry looks promising at present, but this group is the largest supplier to the motor and marine industries, and both trades have slumped. The titanium pigment industry can be considered to be at the end of the steep expansion phase and the coming years

are likely to see only moderate growth. The paint market, at present the largest outlet, is expected to expand at little more than 5% a year.

Sectors where demand for sulphuric acid can be expected to increase are fertilizers, phosphoric paper and cellulose film, although in this last mentioned competition from polythene and polypropylene films is expected to become a little smaller each ye .r, over the next five to eight years.

Transparent Paper Growth Prospects

Growth of the supermarkets has brought with it the need for greater quantities of wrapping materials, paper, and of course, transparent film. British Cellophane Limited plans to meet this challenge, and expansions to its plant at Barrow, which will increase production capacity by one-third, are well under way. When fully operational some 10,000 tons of sulphuric acid and 3,000 tons of carbon disulphide are expected to be used.

British ENKA is now paying greater attention to its transparent paper activities. At Aintree work is being completed on eight new buildings, forming the company's new plant to manufacture viscose-based transparent wrapping films. Production is planned to start about the middle of this year.

Demand for Fertilizers

Despite the many underdeveloped countries' activities in the fertilizer field, overall world demand for fertilizers continues to mount. In particular, there is increasing emphasis on ammonium phosphate fertilizers with their attendant call on phosphoric acid. Important addition of plant, due on stream this year, are being made by Fisons, S.A.I. and Richardsons and the Farmers Company Limited.

In operation since the beginning of April is the 50 tons-a-day sulphuric acid unit at the company's Brigg, Barton-on-Humber, works.

Now out of production is one of I.C.I.'s anhydrite kilns. It is likely to be out of service for at least six months while it is rebuilt. To make up for the loss of production the company's contact sulphuric acid plants mining sulphur will be worked to greater capacity.

At Solway Chemical Company's anhydrite mine at Whitehaven production is being increased from the previous annual rate of 350,000 to 400,000 tons to 500,000 tons in order to meet the expanded sulphuric acid facilities now under way. A third kiln for sulphuric acid production based on anhydrite is now under construction on the Marchon Solway site. Preparation of the site started in November last year.

Increased Capacity for Detergents

Because of the rise in the use of household detergents which contain approximately 30 to 40% of detergent phosphates, phosphoric acid facilities of Marchon Products are being extended and will absorb most of the increased output of sulphuric acid by this company. Under construction at Whitehaven is a third anhydrite kiln which is to be in operation by the end of this year. Marchon's capacity for synthetic household detergents is now some 25,000 to 35,000 tons a year, while production of specialized and highly concentrated detergents is at an annual rate of 10,000 tons.

Future Consumption

Consumption in 1961 can be expected to total 2.9 to 3 million tons of sulphuric acid, an increase of about 5 to 6%. Some 50% of anticipated consumption can be expected to be met from indigenous resources and the additional requirements will be provided by U.S. and Mexican sources and from Lacq recovered sulphur in France. Total import requirements are expected to rise to about 520,000 tons brimstone and 300,000 tons pyrites.

Pyrites...

COMPAÑIA ESPAÑOLA de MINAS de RIO TINTO S.A.

THE THARSIS SULPHUR AND COPPER CO. LTD.

Pyrites is a stable, assured and competitive source of sulphur. The Tharsis and Rio Tinto mines in Spain have supplied pyrites for over eighty years. Their known reserves are unrivalled.

← The Tharsis Company's pyrites storage depot at Huelva.

...Europe's principal source of sulphur

New Titanium Dioxide Capacity Will Expand Sulphuric Acid Consumption

Acid requirements likely to be 5½m. tons by 1970

PROJECTS which were under consideration when the world titanium dioxide boom was at its height have now been, or are about to be, realised (see also "Sulphur" No. 28, May 1960). In spite of the new capacity which will result, however, there are definite indications that world capacity is growing at a slower rate than in the decade 1949-59, when capacity roughly trebled. It is expected that world production, outside Communist countries, will double in the next 10 years, and may reach 1½ million tons by 1970, by which year the sulphuric acid requirements of the industry are likely to be in the region of 5½ million tons.

Australia

Laporte Industries Limited of Great Britain is planning the erection of a 10,000 tons a year titanium dioxide plant in Australia, one of three plants planned by Laporte in different parts of the world. The new plant and an associated sulphuric acid unit will be located at Bunbury, near Perth, Western Australia, and will utilise ilmenite, of which reserves in the Bunbury Bussleton area have been assessed at 15 million tons. It is expected that the new plant will cost £3.5 million and be in production by 1964.

India

At Bombay, India, Laporte plans to participate with Bombay Dyeing and Manufacturing Company in the erection of a 4,500 tons a year titanium dioxide plant. A new company, in which the India partner holds the major interest, has been registered jointly for this purpose. Sulphuric acid will be provided from the nearby 20,000 tons a year plant of Dharamsi Morarji Chemical Company Limited. The proposed plant will produce, annually, 3,000 tons of anatase titanium dioxide and 1,500 tons of rutile grade; at present only the anatase type of titanium dioxide is produced in India.

At Trivandrum, capacity of the 1,800 tons a year plant of Travancore Titanium Products Limited is being extended to 3,600 tons a year and plans are in hand for a further extension to 6,600 tons a year within the next two or three years. By 1964, therefore, installed capacity is likely to be in excess of 11,000 tons and will provide an outlet for 35,000 to 40,000 tons of sulphuric acid annually.

The subject of import duty on titanium dioxide is currently under review by the Indian Tariff Commission. The present import duties, in force until the end of the year, are 35% *ad valorem* (preferential) and 45% (standard) *ad valorem*. It has been pointed out by the Indian Paint Association that while locally produced material has generally proved satisfactory, certain batches have been below standard, particularly as regards whiteness. In addition, soap and cosmetic manufacturers have stated that traces of copper and iron in the indigenous material make it unsuitable for their use.

South Africa

British Titan Products and African Explosives and Chemical Industries Limited are jointly erecting a 10,000-tons-a-year plant at Umbogintwini. Raw materials for the £3 million plant will include ilmenite which will probably be obtained from nearby Umgababa and sulphuric acid which will be provided from African Explosives' existing 251,000-tons-a-year plant at Umbogimtwini. W. J. Fraser and Company Limited, of Romford, Essex, are the main contractors for the plant which is expected to commence production early in 1962. Sulphuric acid requirements for the new venture are expected to be some 35,000 to 40,000 tons annually.

Canada

In Canada, a 50% expansion of its 18,000 tons a year plant at Varennes, Quebec, is planned by Canadian Titanium Pigments Limited. It is reported that expansion will be achieved by removing existing bottlenecks and will consequently involve only a small outlay of capital. The new unit will utilise

titanium slag as raw material and sulphuric acid will be supplied from the company's existing 50,000 tons a year sulphuric acid plant.

Continental Titanium is erecting a 2,200 tons a year titanium dioxide plant near Baie St. Paul and a large 20,000 tons a year unit is also under construction by British Titan Products Company Limited at Sorel. By the end of 1962, therefore, new and existing capacity of anatase and rutile types of titanium dioxide will together total some 50,000 tons and will exceed market requirements by about 20,000 tons. The two major producers, British Titan Products and Canadian Titanium Pigments, are endeavouring to obtain increased tariff protection for the locally produced materials. Currently, titanium dioxide is imported from Great Britain free of duty and material from 'Most Favoured Nations' carries a tariff of 12½%. The two producers have proposed to the Tariff Board that these rates should be raised to 15% and 20%, respectively. It is expected that the proposed changes will be strenuously opposed by, *inter alia*, the pulp and paper industries which imports approximately 1,500 tons a year and Laporte Titanium which imports some 500 tons a year from its British parent company.

West Germany

Titangesellschaft m.b.H., jointly owned by Farbenfabriken Bayer AG. and National Lead Company, of St. Louis, Mo., plans a large expansion of its 50,000 tons a year titanium dioxide plant at Leverkusen. Issued capital is being increased by seven million DM to 50 million DM, the additional capital being provided by National Lead. Sulphuric acid for the expanded plant will be provided from Bayer's existing sulphuric acid installations.

Italy

In Italy, expansion of the Spinetta Marengo Works of Soc. Montecatini by 22,000 tonnes a year is now at an advanced stage. When complete, the installation will raise Montecatini's installed titanium dioxide capacity to a level of 40,000 tonnes a year. Sulphuric acid for the new unit will be provided by Montecatini's existing sulphuric acid plants, and annual requirements are likely to be of the order of 65,000 tonnes.

Portugal

A new company, Pigmentos de Titanium S.A., has been formed by the Portuguese firm, Sociedad Mineira de Santa Fe and Fabrique de Produits Chimiques de Thann et Mulhouse and St. Gobain S.A., both of France, to erect and operate a titanium dioxide and sulphuric acid complex at Cabo de Sinnes, 55 miles south of Lisbon. Raw materials for the proposed plant will be from the large deposits of titanium ore controlled by the Portuguese concern. The two French companies will together contribute £3.75 million towards financing the project and will also provide technical assistance and manufacturing know-how.

Spain

Authorisation has been granted to Union Quimica del Norte de España to expand production capacity for titanium dioxide at its plant at Axpe, in Bilbao. The expansion will be completed by 1963.

U.S.A.

Erection of a $15 million titanium dioxide plant in California is jointly planned by Laporte and American Potash and Chemical Corporation of Los Angeles. Initial capacity will be 25,000 tons a year and provision will be made during erection for further expansion. Laporte, which holds a 15% share in the new venture, will provide technical know-how and will also make available titanium dioxide for market development whilst the plant is being built. Sulphuric acid will be provided by American Potash and Chemical, probably by purchase from sulphuric acid producers in the vicinity. The new plant is expected on stream in 1962 and will be the first titanium dioxide plant in the West Coast area.

Japan

Largely as a result of increased demand in both the domestic and export markets, three Japanese firms are enlarging their existing titanium dioxide capacities. At Osaka, Teikoku Chemicals Industry Limited is expanding

annual capacity from 5,400 tons to 12,000 tons and expansion also to 12,000 tons a year is under way at the Tokyo plant of Tochigi Chemicals Industry Limited. Both are expected in production during 1961. Furukawa Industry Limited plans to increase the capacity of its 3,800 tons a year Osaka plant to 12,000 tons a year by 1962. With a 12,000 tons a year expansion recently completed by Ishihara Sangyo Kaisha K.K. at Yokkaichi, titanium dioxide capacity in Japan is likely to reach a level of 78,000 tons by 1962 and will provide offtake for an estimated 200,000 tons of sulphuric acid.

Orders for the Stretford Process

TO DATE five orders and 65 enquiries from all over the world have been received for the Stretford process*.

In the Stretford process two anthraquinone disulphonic sodium salts in water solution are used. Pure sulphur precipitates out of solution when H_2S reacts with anthraquinones to produce hydroquinones. The latter are oxidized back to anthraquinones*. The process may be considered a variation of the Becco† hydrogen peroxide process in which an alkylated anthraquinone is alternately hydrogenated to hydroquinone and the reaction reversed by oxidation to split off H_2O_2. North Western Gas Board and Clayton Aniline Limited have achieved sufficient water-solubility by introducing two sulphonic groups in the molecule to carry out sulphide conversion in water solution.

Three orders for installations in the U.K. have been received by W. C. Holmes and Company Limited, Huddersfield. At the Stapleton Road gasworks of South Western Gas Board at Bristol a Manchester process plant is to be converted treating a gas stream of six million cubic feet a day containing about 1% H_2S by volume. Some 6,000 lb. sulphur a day will be recovered as a paste containing 40 to 50% water. For the present, purification of the gas is the main criterion, but Holmes is planning to install equipment for the economic conversion of the sulphur paste obtained in the Stretford plant into pure block sulphur.

The other two orders are from companies outside the gas industry—from Courtaulds Limited and Midland Tar Distillers Limited.

Another licencee of the Stretford Process*, R. and J. Dempster Limited, Newton Heath, Manchester 10, has received an order from Belgium for a sulphur recovery plant based on the process. The plant ordered by Distrigaz of Antwerp will process 10.7 million cubic feet of refinery gas a day containing 0.5% hydrogen sulphide. It will be the first Stretford plant to be installed on the Continent. Dempsters will carry out the construction and engineering of the plant which is expected to be ready for commissioning in December this year, and is being prefabricated in the U.K. and smaller vessels will be despatched complete and large vessels assembled on site.

It is believed that the plant has been ordered for the main Antwerp gas works. Some two tons of sulphur a day will be recovered and sold.

Dempster is also to build a Stretford sulphur extraction plant for South Eastern Gas Board at the Norwich gasworks to treat four million cubic feet a day of gas. Sulphur will not be recovered.

Courtaulds plans to install a Stretford plant at the company's Carrickfergus works in Northern Ireland. A gas stream, the actual throughput of gas being of 1,000 cubic feet an hour containing 60% H_2S and 40% carbon dioxide by volume, will be treated.

The order for Midland Tar Distillers is associated with a new chemical process which is under development. Some difficulties are understood to have arisen with regard to the chemical process, which is believed to be the refining of benzene to produce a high-purity product by removal of carbon disulphide.

Humphreys and Glasgow Limited has an order from Transparent Paper Company for a pilot plant to use the Stretford process for removal of small quantities (0.5%) of hydrogen sulphide from effluent air. No sulphur will be recovered as the amount removed per day will not make recovery worthwhile.

* See Sulphur 31, page 35

† Becco Chemical Division, Food Machinery and Chemical Corporation

National Sulphur Congress in Sicily

Future of Sicily's sulphur industry examined

Don Francesco Lanza di Scalea, President of Ente Zolfi Italiani, the congress chairman, giving his opening address

UNDER the auspices of Ente Zolfi Italiani a National Sulphur Congress met at Palermo at the end of March. The object of the Congress was to draw up a blueprint for the future of the Sicilian Sulphur Industry in the light of the technical, social and financial problems which are threatening its survival.

In his opening address the chairman, Don Francesco Lanza di Scalea, President of Ente Zolfi Italiani, reviewed past problems and outlined the main features of the proposed course of action.

Ente Zolfi Italiani, in co-operation with Veruschacht AG. of Essen and with funds contributed by the Italian and Federal German Governments, has been engaged for the past two years on a mine modernisation programme designed to permit production of sulphur ore at a substantially reduced cost. Parallel with this activity Fraser, Weir & Associates Inc. of Chicago had been engaged in a work study of mining conditions, the results of which have a direct bearing on the modernisation proposals of the Italo-German team.

Papers were presented by:—

Prof. Giuseppe Tucci, University of Siena
Economic outlook for Sicily, with reference to the development of the chemical industry within the Mediterranean economy.

Dott. Gabriele Morello, Director, ISIDA
Possibilities of re-employment of labour forces available after re-organisation of the sulphur industry.

Mr. Hugh Howard Fraser, President, Fraser, Weir & Associates
The results of the studies and experiments carried out in a group of Sicilian Sulphur mines.

Ing. Enzo Beneo, Director, Servizio Geologico d'Italia
The principles of research and the outlook in the sulphur mining industry.

Eng. Guenther Mathes, Veruschacht AG. of Essen
The present situation and the future structure of the Italian sulphur industry.

Prof. Dr. Werner Gruender, University of Berlin
Dressing of Sicilian sulphur ore.

Prof. Dr. phil. H. Koelbel, University of Berlin
Possibilities of converting Sicilian sulphur into chemical products.

Prof. Dr. Fritz Mohr
The sulphur industry as an economic unit in Sicily—Conclusions drawn from the studies conducted.

Dr. Rene Leclercq, Vice-President, Sulphur Institute
New possibilities of sulphur use in chemistry and other fields.

Ag. Eng. N. Charliers
Some particular aspects of the importance of sulphur in agriculture.

Recommendations

In essence the recommendations placed before the Congress in the papers of the German experts, which may be said to reflect closely the views of Ente Zolfi Italiani, would entail the following main features:—

1. The drastic rationalisation of the industry by the closure of all small mines and operation of a limited number of major mines where reserves of 17 to 18 million tonnes ore would offer an operation life of about 15 to 20 years.

2. The vertical integration of ore mining with fertilizer manufacture by the establishment of a plant burning sulphur ore for sulphuric acid manufacture within

economic transport distances from selected mines, ready access to ammonia supplies based on oil refinery gases and benefiting from the short haul of phosphate rock from Tunisia and potash salts from the new Sicilian mines.

3. Cessation of fused sulphur production and probably also of production of sulphur concentrates.

The proposed plant would have an annual intake of 625,000 tonnes sulphur ore to produce 327,000 tonnes (100% H_2SO_4) sulphuric acid, of which one-quarter would be used in the manufacture of 125,200 tonnes ammonium sulphate and three-quarters converted to phosphoric acid for the manufacture of 102,700 tonnes triple superphosphate and 450,000 tonnes complex fertilizers, mainly of the 15:15:15 type. Ammonia requirements of the plant would be 115,000 t.p.a. NH_3 and total output of all fertilizers would be 680,000 tonnes. The cost of ore could be brought down to Lire 170 per unit of sulphur (approximately 2s. or U.S. ¢28) delivered to the fertilizer plant.

Official View

Official views by the Under Secretary of State of the Italian Ministry of Industry, Dr. Biaggi, and Sicilian Government officials, vocal replies by Sicilian Trade Union leaders and reserved judgement by Dr. Larzetti of the Confederation of Italian Industry—who contrasted the huge capital cost of the project with the relatively small number of displaced miners, were sulphur mining to cease in Sicily —were among the large number of comments on the prepared papers.

Following a brilliant and meticulous summing up of all views and sentiments by Prof. Mario Carta of Cagliari University, agreement and support were officially given by the Mine Owners, Trade Unions and Government Representatives to the proposals and it was agreed to establish a committee to draw a detailed feasibility study of a fertilizer project which will entail the expenditure of Lire 47½ milliard (£27½ million) of which a part is to be sought from the European Investment Bank. The project does not encompass the activities of Soc. Montecatini whose fused sulphur production is declining, but whose sulphur ore output from the company's own mines and its associates' is mounting to meet growing demand at Porto Empedocle. The supply of sulphur ore to the Priolo works of Sincat is also excluded, as well as the exact future of the producers of sulphur concentrates. It is estimated that if the project is realised sulphur ore production in Sicily will originate from 15 to 20 mines at an annual rate of 1.0 to 1.2 million tonnes of ore averaging 25%.

Under the Rome agreement of European Common Market Countries, the Italian sulphur market enjoys limited protection for 7 to 8 years from 1960, to facilitate reorganisation of the industry. It is foreseen that once stocks are absorbed, imports of crude sulphur to meet domestic needs would be channelled through Ente Zolfi Italiani, which is to continue rendering technical advisory and management services to the sulphur industry.

Sulphur Extraction Trials in Philippines

SULPHUR ore refining tests are at present being conducted by Camiguin Mining Company. The kiln which is being used is based on a design of a similar installation in Spain for processing low-grade sulphur ore and for which Camiguin Mining has been granted a patent. The kiln has been somewhat modified.

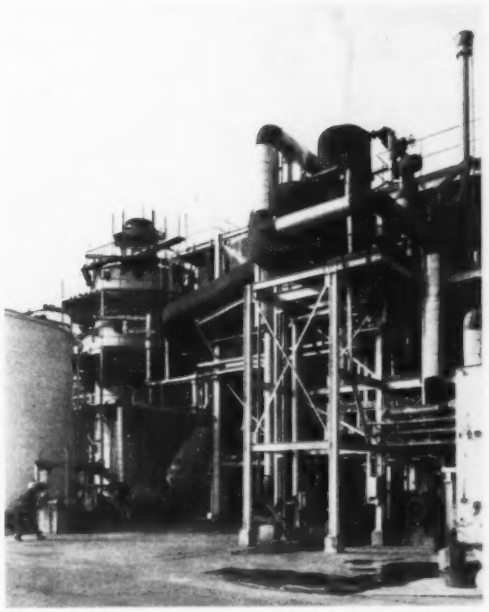
Source of the sulphur is volcanic ores at Camiguin Island in the northern part of the island of Luzon. The ore is reported to contain up to 56% sulphur.

Elemental sulphur production in the Philippines amounts to some 1,300 tonnes a year. Pyrites concentrates are produced by Atlas Fertilizer Corporation, and output totalled some 12,255 short tons in 1959, and to meet domestic needs, about 2,540 tonnes was imported in 1959.

There are ample supplies — actual and potential — of by-product pyrites derived from copper concentrate tailings. At present the only producer is Atlas Fertilizer Corporation and output in 1959 totalled some 12,255 tonnes, which was wholly used for sulphuric acid production.

Liquid Sulphur Sales Increase in the U.S.

Frasch producers' optimism about Prospects for 1961



Latest large sulphuric acid regeneration plant at Hammond, Indiana, of Stauffer Chemical Company, New York

PRODUCTION of Frasch sulphur in 1960 totalled 4,942,762 tons, an increase of 389,128 tons, or over 8.5%, over 1959. In contrast to the previous year, production in 1960 was approximately equivalent to requirements and reduction of stocks was at a much lower level.

During the year two new domes were brought into operation by Freeport Sulphur Company at Grand Isle and Lake Pelto, the former being the world's first offshore sulphur dome. U.S. Sulphur began operations at its small High Island dome in November and Duval Sulphur and Potash Company continued a programme of modernisation at the company's Orchard dome in 1960, which contributed to decreased production costs. Jefferson Lake Sulphur Company closed two domes in December 1960; there are now a total of 12 domes in production.

Monthly Frasch Process Sulphur Production 1959 and 1960

	Long Tons	
	1959	1960
January	346,475	388,630
February	317,696	366,357
March	373,599	436,530
April	390,757	424,421
May	389,212	420,290
June	346,887	393,931
July	318,192	419,891
August	368,561	453,555
September	399,157	372,514
October	483,089	389,930
November	408,481	399,624
December	411,531	477,089

In 1960 the major Frasch producers increased their sales of liquid sulphur to satisfy the ever-increasing demand for this material. The main reason for this trend is that most sulphur, for either acid or non-acid consumption, is used in liquid form and must be melted if delivered in solid form.

New Facilities

Texas Gulf Sulphur Company, the pioneer in the molten sulphur field, increased its facilities for handling, storing and transporting liquid sulphur in 1960, and it is estimated that some 800,000 tons of molten sulphur will be sold by the company in 1961, more than double the level of 1960. In December, Freeport Sulphur Company initiated a $23 million programme for the erection of facilities capable of handling some 1.5 million tons of molten sulphur or nearly two-thirds of the company's annual sales. It is estimated that in 1960, some 700,000 tons of sulphur was supplied to consumers in liquid form; a figure which will substantially increase in the next two or three years as a result of new molten sulphur facilities for handling and storage, planned or under construction by both the major producers and the major consumers.

Apparent Sales

Apparent sales of Frasch sulphur in 1960 amounted to 5,083,914 tons, slightly below the 1959 level of 5,185,992 tons. Exports in 1960 were above (11%) the level achieved in 1959 but were more than offset by reduced domestic deliveries, which were 6.7 lower than in 1959.

Stocks

Stocks, which at the end of December 1960, totalled 3,668,556 tons, show a decrease of 141,152 tons compared with a year ago. Reduction of stocks in 1960 was, however, well below the order of magnitude achieved in 1959, when 632,358 tons were cleared.

Recovered Sulphur

Production of recovered sulphur in 1960 reached a record level of 724,022 tons, representing a significant increase of 73,259 tons (11.3%) over the previous year. In contrast to the Frasch sulphur industry, apparent sales also showed a significant increase of 67,012 tons over the 687,788 tons sold in 1959 and exceeded production by over 30,000 tons for the second successive year. Consequently, stocks at the end of the year had been reduced to 109,467 tons, a decrease of 30,799 tons compared with stocks at the end of December, 1959.

Trade

Imports of sulphur by the United States in 1960 amounted to 750,000 tons, compared with 650,000 tons in 1959; an increase of 15%. Of these, Canadian shipments of recovered sulphur accounted for 150,000 tons, representing a large increase of 125,000 tons compared with the previous year. Imports of Mexican Frasch sulphur, on the other hand, showed a small decrease of 25,000 tons in 1960.

Exports of Frasch sulphur in 1960 reached a new record level of 1.79 million tons, an increase of 11% over the previous year, despite increased competition from Canada and Lacq. Exports to Western Europe, which were nearly 85,000 tons higher than in 1959, accounted for the bulk of the increased shipments.

Consumption

Consumption of Frasch and recovered sulphur in 1960 reached a level of 5 million tons, slightly above the 4.975 million tons consumed the year before. After the relatively high levels of domestic consumption achieved in the first and second quarters of the year, domestic consumption declined significantly in the second half of the year, largely due to decreased sulphuric acid consumption. While consumption of recovered sulphur registered a significant increase in 1960 of 200,000 tons or 25%, consumption of Frasch declined by 175,000 tons.

Consumption of sulphur in all forms, including sludge acids, reached a record level of 6.4 million tons in 1960, an increase of nearly 1% on the previous year.

Consumption of pyrites showed no change over the levels in the previous years, but consumption of smelter gases and other sources of sulphur showed a small increase of 6%.

Of the main non-acid consumers of sulphur, the sulphite and pulp industry registered a steady increase in output, which was 6.7% higher than in 1959; a similar increase (6.6%) was shown by dissolving pulp. Production of synthetic and reclaimed rubber declined in the second half of 1960, reflecting the recession in the motor industry, but combined output in 1960 was still above the level of 1959.

Recovered Sulphur in 1959 and 1960

	Production	Mine or Plant Shipments	Apparent Sales	Producers' Stocks
1959				
1st Quarter	165,401	169,101	165,145	177,527
2nd Quarter	164,572	183,711	179,188	162,911
3rd Quarter	159,762	170,078	168,462	154,211
4th Quarter	161,028	177,576	174,993	140,246
1960				
1st Quarter	174,738	186,903	191,971	123,013
2nd Quarter	174,947	188,076	187,841	110,119
3rd Quarter	183,641	181,896	189,869	103,891
4th Quarter	190,696	184,066	185,119	109,467

Sulphuric Acid Production
(short tons)

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1960				
Total	**4,710,305**	**4,646,557**	**4,090,111**	**4,311,544**
Chamber Process	573,543	519,129	344,154	443,857
Contact Process	4,132,762	4,127,428	3,745,957	3,919,391
1959				
Total	**4,450,439**	**4,646,806**	**4,049,169**	**4,463,107**
Chamber Process	593,914	559,492	390,776	503,365
Contact Process	3,886,525	4,087,314	3,658,393	3,959,742

Largely due to increased competition from other man-made fibres, output of the rayon industry, a large consumer of sulphur, dropped sharply from 867.2 million lb. in 1959 to 740.3 million lb. in 1960, losing ground to non-cellulosic fibres and textile glass fibres, which registered a significant increase in that year of 8%. Use of rayon in tyre manufacture declined in 1960 owing to competition from nylon, and since profit margins on the former material are much lower than on the latter, long-term prospects for the rayon industry are not very bright.

Parallelling the decline in rayon production, production of carbon disulphide also declined. The increased use of methane as a raw material for carbon tetrachloride production was another factor contributing towards this trend. It is estimated that sulphur consumed in carbon disulphide manufacture declined by 12.5% to a level of 200,000 tons.

Other non-acid uses of sulphur also decreased by 12.5% in 1960, resulting in an overall decline of sulphur consumption by non-acid users of 50,000 tons.

Sulphuric Acid

Gross production of sulphuric acid in the year 1960 amounted to 17,800,221 short tons (100% H_2SO_4), compared with 17,609,521 short tons in 1959, an increase of 190,700 short tons. Production of virgin sulphuric acid amounted to 17,026,041 short tons in 1960, compared with 16,909,502 short tons in 1959, an increase of 116,539 short tons or 0.7%.

Output of spent acids increased in 1960 and totalled 774,000 short tons, which was 10.6% higher than the 1959 level of 700,000 short tons.

It is estimated that the industry operated at about 75% of capacity in 1960 and supply was, consequently, well in excess of demand. Sulphuric acid output was significantly higher in the first half of the year (9,356,862 short tons) than in the first half of 1959, when 9,094,088 short tons was produced. Output in the third quarter reflected the summer seasonal slack, but the anticipated increase for the fall and early winter did not develop.

As a result of ample stocks, competition increased in 1960 and profit margins improved little or not at all, many manufacturers being hard pressed to maintain profitable operations. 1960 was a particularly bad year for producers selling on a merchant basis. An increasing number of manufacturers with large acid requirements, such as for fertilizer, uranium production, titanium dioxide and aluminium sulphate, are now producing their own sulphuric acid. As a result, sulphuric acid merchants are not participating in the overall expansion and many are now turning to the manufacture of products which use sulphuric acid. It is estimated that nearly 40% of all sulphuric acid was used captively in 1960.

Increased output of sulphuric acid was almost entirely due to increased contact process production and output of lead chamber acid showed a decline in keeping with long-term trend. Over the last 10 years, virtually all the sulphuric acid plants which have been built or are scheduled for construction, are of the contact type, and lead chamber plants are not being replaced when they become worn out.

Consumption of sulphuric acid by the fertilizer industry, the largest user of sulphuric acid, showed a small increase in 1960. Output of wet process phosphoric acid totalled 1,317,998 short tons P_2O_5, and this was an increase of 165,854 short tons, or nearly 16% over 1959.

Sulphuric Acid Capacity and Production, 1950-1960
(Thousands of short tons, 100% H_2SO_4)

Year	Rated Capacity for New Acid as of January 1st	Gross Incl. Spent	Chamber	Contact	Total New Acid	% Capacity	Spent Acid
1960 ...	22,570	17,800	1,875	15,150	17,026	75.4	774
1959 ...	21,600	17,609	2,081	14,887	16,909	78.3	700
1958 ...	20,440	15,950	1,742	13,538	15,280	74.7	670
1957 ...	19,500	16,460	1,988	13,780	15,768	80.9	692
1956 ...	18,600	16,495	2,234	13,504	15,738	84.6	757
1955 ...	17,440	16,225	2,321	12,998	15,319	87.8	936
1954 ...	15,970	14,376	2,512	11,045	13,557	84.9	820
1953 ...	14,560	14,003	2,736	10,291	13,027	89.5	976
1952 ...	14,220	13,310	2,711	9,634	12,345	86.8	965
1951 ...	13,410	13,372	2,886	9,503	12,389	99.8	983
1950 ...	12,060	13,029	2,956	9,187	12,143	100.7	886

As a result, manufacture of triple superphosphate registered a large increase of 12%, in terms of available P_2O_5, and an even larger increase was shown by ammonium phosphates and other complex fertilizers, which increased by 25%. Output of all phosphatic fertilizers increased by only 3%, largely due to a decline in single superphosphate manufacture, which decreased by 8%.

It is estimated that the phosphatic fertilizer industry consumed 575,000 short tons of sulphuric acid, an increase of 250,000 short tons compared with 1959.

Largely due to increased competition from high-analysis nitrogenous fertilizers, such as urea, anhydrous ammonia and ammonium nitrate, output of synthetic ammonium sulphate in 1960, at 875,055 short tons, was well below the level of 1,099,437 tons produced in 1959. This was only partially counterbalanced by a very small increase in by-product ammonium sulphate manufacture. It is estimated that the use of sulphuric acid for ammonium sulphate manufacture declined by 100,000 tons in 1960.

After a very high level of production achieved in a first quarter of 1960, output of the steel industry, which currently used 5% of all sulphuric acid consumed in the U.S., progressively declined in the remaining three quarters of the year. By December, production had fallen to 46% of rated capacity. The fall in steel production was largely due to the recession in the car industry in the latter half of the year.

In the white pigment industry production of titanium dioxide in 1960 amounted to 454,988 short tons (100% TiO_2) as against 495,082 short tons in the preceding year, a decrease of 40,094 short tons. Stocks held by the producing companies were slightly reduced by some 7,000 tons over the year, but sales were substantially lower than in 1959.

Output of commercial grade sulphate declined by about 10,000 tons from the record production of 897,068 short tons in 1959. With two new aluminium sulphate plants expected on stream in 1961, however, sulphuric acid consumption by the industry is likely to increase in 1961.

Outlook

In spite of the unspectacular results achieved in 1960, sulphur producers regard prospects for 1961 with a certain degree of optimism. Sulphuric acid production is expected to increase again this year at a slightly higher rate, and by the end of the year industry sources estimate that capacity will approach 25 million tons. New acid facilities, planned or under construction, are expected to increase total U.S. capacity by 1.5 million short tons and supplies are expected to be more than adequate for all end-uses in 1961. The greater part of the new capacity will be used captively for manufacture of wet process phosphoric acid and superphosphates at plants mainly located in Florida, the Mid-West and the Western States.

In addition to the manufacture of wet process phosphoric acid and concentrated phosphatic fertilizers, greater use of sulphuric acid is expected in the manufacture of ammonium sulphate, aluminium sulphate, hydrofluoric acid, titanium dioxide, uranium, petroleum, detergents, and in iron and steel pickling.

It is anticipated that the state of the industry in 1961 will be ultimately determined by the operating rates of the large consuming

industries such as steel, copper, aluminium, petroleum, cars, chemicals, explosives and rayon, as well as general business and financial conditions. There are indications that the steel industry is recovering from the recession in 1960, and production is now stabilised at more than 1.5 million tons a week; its highest level since June 1959, despite sweeping cuts in car output. It is envisaged that the production pattern in 1961 will be the exact reverse of 1960, rising from a low level in January to a substantially higher level by the mid-year. Because of the multiplicity of its end uses, many observers feel that the partial recovery in the steel industry will be parallelled by improved business generally, and are consequently optimistic about prospects for 1961.

Due to increasing competition from material imported from Canada, Frasch sulphur production is unlikely to exceed the 1960 level and may even show a small decrease. Exports are also likely to decline slightly due to increasing competition from Lacq and Canadian sulphur. Recovered sulphur, on the other hand, is likely to increase, and may well reach a record level of 775,000 tons.

In spite of increasing competition, the outlook for the U.S. sulphur industry in 1961 is fairly promising. Consumption of all forms of sulphur, including sludge acid, is likely to increase, and may reach a record level of 6.6 million tons, mainly in the acid-consuming sector.

Large Sulphur Sour-Natural Gas Processing Plant for Canada

To be operated by newly-formed Petrogas Processing Limited

ONE of the largest sour natural gas treatment and sulphur conversion plants to be constructed in North America will be located at Calgary, and will be operated by the newly formed company Petrogas Processing Limited, of Calgary, Alberta. Based on a processing capacity of 150 million cu. ft. per day of sour natural gas the plant will, besides production of 863 long tons a day of brimstone from extracted hydrogen sulphide, have a daily output of 107 million cu. ft. of pipeline gas for export into the Western United States market and 2,200 barrels of stabilized condensate for use in Alberta refineries.

Petrogas Processing Limited has been formed by Jefferson Lake Petrochemicals of Canada Limited with 27 other oil and gas companies which own the greater part of the Calgary gas field reserves*. The two principal gas producing zones are the Elkton formation, embracing some 23,770 surface acres and the crossfield formation embracing 43,120 surface acres. Jefferson Lake has been appointed operator of Petrogas to co-ordinate, construct and manage the plants facilities upon completion. Initial capital investment for the facilities to be built by Petrogas is estimated at $13 million. Engineering and construction contracts are being finalized by Petrogas Processing with Ralph M. Parsons Company of Canada Limited, Pipe Line Technologists (Alberta) Limited, Banister Construction Limited and other service and equipment suppliers. Canadian Pacific Railway Company has completed over four miles of rail track into the plant site, and preliminary construction has been started. Completion of the plant facilities is forecast for December 1961.

The sweet gas sold to West Coast Transmission Company Limited on a 20-year contract will be exported by pipeline through the Alberta Trunk Line into the Western United States.

* Ownership of Petrogas Processing Limited has been subscribed for on the basis of each company's estimated natural gas field reserves and their proportionate part of the plant facilities cost to process their own gas reserves. Companies having paid for their equity ownership of the new company are: Alminex Limited, Bailey Selburn Oil and Gas Limited, Banff Oil Limited, Britalta Petroleums Limited, The British American Oil Company Limited, Calvan Consolidated Oil and Gas Company Limited, Canada Cities Service Petroleum Corporation Limited, Canadian Pacific Oil and Gas Limited, Canadian Superior Oil of California Limited, Devon-Palmer Oils Limited, Home Oil Company Limited, Imperial Oil Limited, Jefferson Lake Petrochemicals of Canada Limited, Mobil Oil of Canada Limited, Lehman Brothers, Lincoln-McKay Development Company Limited, Medallion Petroleums Limited, Canadian Petrofina Limited, Pacific Petroleums Limited, Phillips Oil Company Limited, Royalite Oil Company Limited, Scurry-Rainbow Oil Limited, Selbay Exploration Limited, Texaco Exploration Company, Union Oil Company of California, Western Leaseholds Ltd.

Liquid Sulphur Transportation in U.S.A. and Mexico

Frasch sulphur producer's tankers and barges in operation

Two of the three storage tanks at M.T.R.'s Sulphur Terminals Corporation's Tampa, Florida, terminal. Total storage capacity is 30,000 long tons of molten sulphur. The terminal is being operated by Sulphur Chemicals Company Inc. under long-term contract with Freeport

SINCE the beginning of this year three major Frasch sulphur producers have brought into operation ocean-going sulphur tankers and at the same time have substantially increased their handling and storage and distribution facilities for liquid sulphur.

Texas Gulf Sulphur Company has sulphur terminals at Beaumont, Ciucinnate and Carteret, New Jersey, and a new terminal under construction at Norfolk, Virginia*. Freeport Sulphur Company is expanding its liquid sulphur service at Port Sulphur, and in addition is constructing up-river terminals at Jolliet, Illinois, near Chicago, and at Wellsville, Ohio, near Pittsburgh*.

The site chosen for Pan American Sulphur Company's molten storage facilities is Tampa, Florida*. Storage facilities are estimated at $2.25 million. A 1,000 tons liquid sulphur storage tank and sulphur filtration have been completed, and liquid sulphur deliveries by the company's converted T-2 tanker of 15,000 tons capacity were due to begin in May. The tanker is expected to transport 400,000 tons of liquid sulphur annually.

Gulf Sulphur Company is transporting liquid sulphur by barge down the Coachapa and Coatzacoalcos Rivers to the company's filtering dockland storage facilities at Puerto Mexico. Three barges, two of 600 tons capacity and one of 470 tons capacity, are used and 22 other craft*.

Liquid Sulphur Tankers and Barges in the U.S.A.

In February, Freeport Sulphur Company completed its largest shipment of liquid sulphur —16,100 long tons—in an ocean-going converted tanker of the T-2 type, the *S.S. Louisiana Sulphur*, from Port Sulphur, La., to Tampa, Fla. The voyage marked the inauguration of the company's coastal tanker service which is being operated by Joshua Hendy Corporation and is part of its new $23 million programme for transporting liquid sulphur. Similarly, a converted tanker of the T-2 type capable of hauling 15,000 tons of molten sulphur, the *S.S. Marine Sulphur Queen*, is in service for Texas Gulf Sulphur Company. Marine Transport Lines Inc., New York City, operate the vessel for Texas Gulf under long-term contract.

The *S.S. Louisiana Sulphur* has five tanks equipped with steam coils. It is planned to extend the tanker's deliveries to terminals up the Atlantic Coast as far north as Bucksport, Maine.

Texas Gulf's 523-foot ocean-going *S.S. Marine Sulphur Queen* is being used to transport sulphur from the company's main storage and loading terminal at Beaumont, Texas, to two new molten sulphur terminals at Carteret, N.J., and Norfolk, Va. Four separate insulated

* Sulphur No. 32, P.27. See also Company Reports, P.49.

cargo tanks have been fitted into the tanker, each having an independent dual pumping system. The tanks are steam heated by means of internal pipe coils fed by two boilers capable of producing 32,000lb. of steam an hour—for sulphur to remain molten it must be kept at a temperature of 274°F.

The tanker can be loaded or discharged at a rate exceeding 1,000 tons an hour, this enables it to tie up, take a full load and be away in less than 15 hours. Texas Gulf estimated that by the end of this year approximately 40% of its more than 2,000,000 tons of annual output will be shipped in molten form—more than double the volume in 1960.

Up-River Programme

Freeport Sulphur also has two up-river terminal locations. The terminal at Joliet, Illinois, is now in operation*, and the facilities at Wellsville, Ohio, will be completed in May. Storage capacity of 30,000 and 20,000 tons respectively is available. Both terminals supply major sulphur consuming areas and the inland waterways are served by special barges up the Mississippi, Illinois, and Ohio Rivers, and other terminals in Florida.

New terminal facilities at Bucksport, Maine, are also in operation. The new installations include two 10,000-ton capacity molten storage tanks. A third terminal at Everett, Mass., will be placed in operation this summer.

New Facilities at Port Sulphur

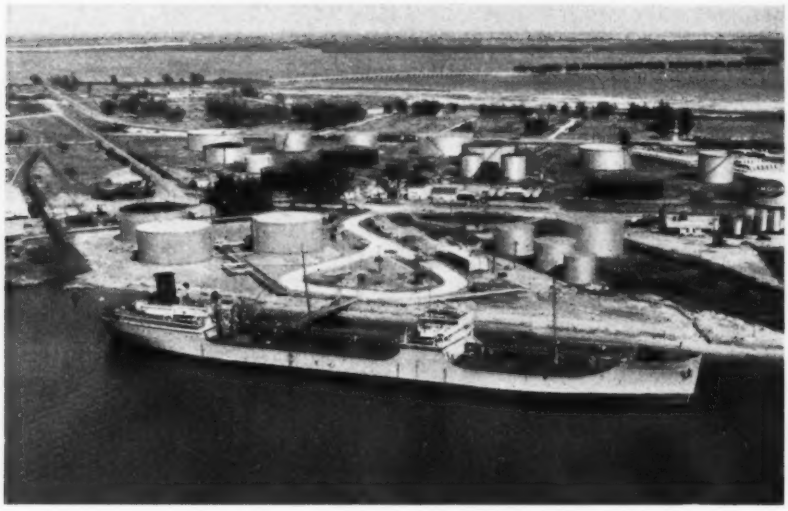
To supply Freeport Sulphur's expanded liquid sulphur service, new storage and loading facilities are being constructed at Port Sulphur, Louisiana. Four new 9,000-ton tanks are being completed to bring total liquid storage capacity to almost 60,000 tons, and a new ship-loading tower is being added to the port's loading facilities.

M.T.R. Terminal at Tampa

In April the molten sulphur terminal, owned by M.T.R. Terminals Corporation and operated by Sulphur Terminals Corporation, was completed. The first shipment of some 16,000 tons arrived by tanker early in March.

Freeport Sulphur's river barges

The barges are high-speed, single-purpose intergrated units, each propelled by a 4,300 horse-power towboat. Each tow has a capacity of 10,000 tons and an overall length of 1,179 feet, or greater than that of the "Queen Elizabeth." Each barge contains two tanks, heavily insulated with fibreglass. Tank temperatures are held at 200°C by hot oil circulating through coils, oil-fired boiler being used to heat the oil. In addition each barge has two diesel-driven 500 ton-per-hour unloading pumps to feed the sulphur to the steam-heated storage tanks on shore.



The *Louisiana Queen* delivering Freeport's first liquid sulphur shipment at Sulphur Terminals Corporation's new storage tank facility at Tampa, Florida

Constructed by Wellman-Lord Engineering Inc. of Lakeland, Florida, and engineered by Bedell and Nelson Engineers Inc., the terminal consists of three permanent storage tanks of 10,000 long tons capacity each and facilities for dockside unloading of tanker ships and loading of two road tankers and a railway tanker at the same time.

The new terminal will serve the needs of Florida's industry, particularly the state's large-scale phosphate operations.

Texas Gulf's *Marine Sulphur Queen* discharging her load of molten sulphur. The insulated piping for transferring the sulphur to the storage tanks is seen in the foreground

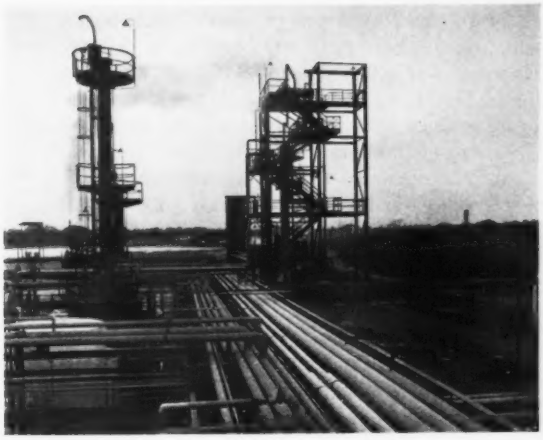
Sulphuric Acid With Simultaneous Production of Nitrogen Fertilizers

UNDER laboratory conditions, two Czechoslovakian workers, N. A. Vasilenko and Z. P. Rozenknop (*Zh. prikl. Khim.* 1960, **33** (9), 1962) have developed a method whereby SO_2 is recovered from waste sulphurous gases by means of ammonia and nitric acid. Concentrated sulphurous gas (15 to 30% SO_2) was thereby obtained together with nitrogenous fertilizers, particularly liquid fertilizers

According to the report, in cleansing gases from an electricity generating station which contained about 0.3% SO_2, expenditure of 1 ton of ammonia and 1 ton of nitric acid trapped 1 ton of SO_2 and resulted in the production of about 1.3 tons H_2SO_4, 3 tons of 'ammiakats' containing about 35% total N and about 0.2 tons of ammonium sulphate containing some ammonium nitrate. The 'ammiakats' produced can be used direct as fertilizer or for ammoniation of superphosphate or in the preparation of complex and compound fertilizers.

Crown Zellerbach Now Producing DMS and DMSO Commercially

Bogalusa process uses sulphur and black liquor



Looking towards the gas scrubber with its vent to atmosphere at Crown Zellerbach's Bogalusa plants for D.M.S. and D.M.S.O.

PRODUCTION began towards the end of last year at the dimethyl sulphide and dimethyl sulphoxide plants of Crown Zellerbach Corporation, leading pulp manufacturers in the U.S.A., at Bogalusa, Louisiana. Capacity of the plant is 10 million lb. a year dimethyl sulphide (DMS) and 5 million lb. a year dimethyl sulphoxide (DMSO), together with 1 million lb. a year methyl mercaptan. Cost of the project is estimated at $1.5 million.

These two units are Crown Zellerbach's first commercial attempt to develop the extraction of important materials from the spent cooking solution (black liquor) of the kraft pulping. Normally, the chemical by-products of the pulp industry are produced from spent sulphite liquor; kraft liquor is valuable enough to be recycled.

The market for DMS is small at the moment. It is used as a constituent of gas odorants and it is a good solvent for many inorganic salts.

As designed, the plant produces much more DMS than is required for conversion to DMSO. But the company believes that the demand for DMSO and other DMS derivatives will soon take up the excess capacity.

DMS as a Solvent

Crown Zellerbach's research laboratories are at present also investigating monochlorodimethyl sulphide, dimethyl sulphone and the use of DMS for solvent extraction of sulphur from native ores.

The chief reason for this development is the potential of DMSO as a solvent for synthetic fibres and agricultural and petrochemicals. In the synthetic fibre field Crown Zellerbach is putting forward DMSO as a directly competitive product with dimethylformamide (DMF) as it has the advantage over DMF of having a very low toxicity—DMF is quite toxic—and being much cheaper to produce.

A large part of the development quantities of DMSO went to two companies in Japan for use in small-scale commercial production of polyacrylonitrile fibres, but in the U.S. fibre industry also there is a large potential market.

DMSO is also a solvent for some agricultural chemicals which are difficult to dissolve. Because of its low toxicity, handling problems would be reduced in this case.

There is also a possible use for DMSO in petroleum refining. It is a good solvent for unsaturated hydrocarbons and aromatics, but a poor solvent for paraffins. It appears to be competitive with DMF for the absorption of acetylene from gas mixtures. It is also a possible ingredient for paint stripping formulations.

Manufacturing Process

The DMS process was originally patented in Sweden in 1955 (USP 2,711,430) and has been extensively developed by Crown Zellerbach at their Camas, Washington, U.S.A., mills. Further improvements have been patented by Crown Zellerbach (USP 2,816,832).

Pulp mill operation produces black liquor which contains 12 to 20% solids; it is very complex but consists essentially of modified lignin and some free alkali and sulphide. The usual procedure is to concentrate the liquor by evaporation to about 60% solids, add make up chemicals such as salt cake, and spray the material into a furnace. The heat generated is normally used to produce steam. The smelt is dissolved and causticised to produce the white liquor used in kraft pulping.

The original system described in the Swedish patent consisted of adding sodium sulphide to concentrated black liquor and heating the mix at 570°F for several hours. DMS is recovered by flashing and condensation. Some methyl mercaptan is also produced and has to be converted to DMS by catalytic reduction with hydrogen sulphide at 660°F. Total yield of DMS is about 65lb. per ton of wood pulp.

A Modified Method

Crown Zellerbach's research laboratories found that by making certain modifications to the process it was possible to obtain comparable yields at lower temperatures and shorter residence times. Yields of nearly 60lb. per ton were obtained in the temperature range of 450 to 500°F without catalytic conversion of mercaptan.

Further modifications have been made, with the result that the Bogalusa process uses elemental sulphur and heats it with the black liquor at 250°C. Crown Zellerbach reports that the modified method not only gives better yields but avoids upsetting the sulphur-sodium balance in the pulp mill.

Methyl Mercaptan Produced

The products are removed by flashing, condensed and purified. The yield is about 80lb. of DMS and 8lb. of methyl mercaptan per ton of pulp.

Liquid phase oxidation with a nitrogen oxide catalyst is used to convert DMS to DMSO. This is also a Swedish process, licensed from Nitroglycerin A/B (USP 2,702,824).

By altering the reaction conditions it is possible to make methyl mercaptan the principal product. It is believed that methyl mercaptan from this source will compete successfully with that produced from methanol. Methyl mercaptan is an ingredient used in making methianine, an amino acid added to animal feedstuffs, and is an intermediate in the synthesis of several commercial chemicals.

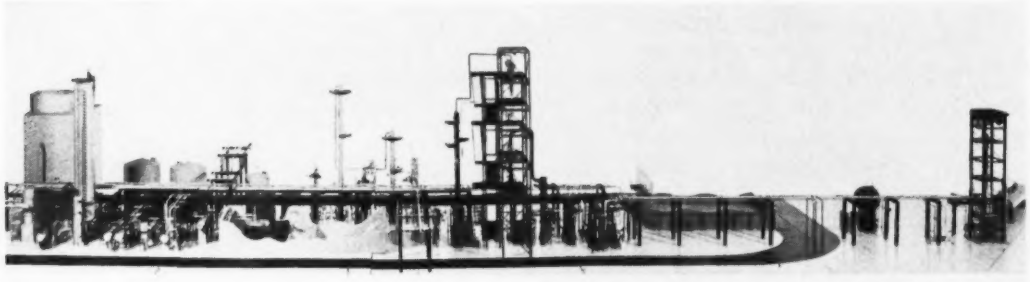
Purity of Product

Crown Zellerbach claim the following purity for DMS:—

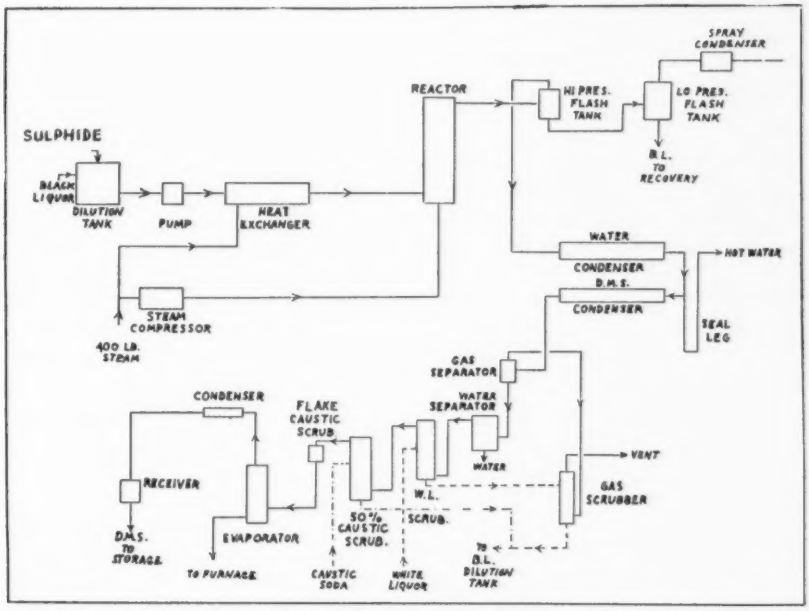
- Less than 0.01% residuals
- Less than 0.05% methyl mercaptan
- Less than 0.15% water
- Less than 0.2 p.p.m. carbon disulphide

It is a water-white liquid boiling at 37°C. It dissolves ethers, esters, alcohols, ketones, aromatic and aliphatic hydrocarbons, halogenated compounds, most amines, monobasic organic acids, rosin, polyisobutylmethacrylate, epoxy resins, polystyrene, polybutylene, polybutadiene.

It does not dissolve significant amounts of aliphatic dibasic acids, aromatic dibasic acids, polythene, urea-formaldehyde resins, polyvinil acetate, bakelite or nylon.



A model of Crown Zellerbach's DMS and DMSO plants at Bogalusa



Flow diagram for the dimethyl sulphide pilot-plant

Chemical Reactions of DMS

Treatment with alkali and sulphur at high temperature converts DMS to the disulphide or polysulphide.

Other reactions include: oxidation with hydrogen peroxide, nitrogen oxide and oxygen, or permanganate to give the sulphoxide or sulphone; halogenation to produce mono and poly halogen compounds; treatment with alkyl and aryl halides to form sulphonium salts; heating with hydrogen sulphide in the presence of a catalyst to form methyl mercaptan; condensation with N-haloamides such as chloramine-T; reaction with propiolactone in the presence of hydrogen chloride to form dimethyl-β-propiothetin; splitting the cyanogen bromide to form methyl thiocyanate and trimethylsulphonium bromide; reaction with polyhydroxybenzene derivates to form methyl phenyl thioethers; and radical exchange with ethers to give mixed thioethers.

Potential Production

The yield of DMS is about 2.5% of the solids in the black liquor. A 400 ton a day kraft mill could therefore produce about 12 million lb. of DMS a year. The present kraft industry in the U.S.A. could produce about 400,000 tons of DMS a year.

The cost of DMS from lignin is much lower than that for the synthetic material previously available. It is expected, as a result of the lower price, that large volume markets will develop.

Four years ago Crown Zellerbach built a pilot plant for DMS production at their research laboratories. Output from this went mostly to Stephan Chemicals for production of DMSO. Manufacture of this product was dropped by Shephan Chemicals in 1959 following an explosion. Crown Zellerbach then decided to produce the solvent by the Swedish process.

While development work went ahead, output of the pilot plant was increased to 2 million lb. a year, providing enough material for limited commercial production of DMSO. At the same time Crown Zellerbach contracted with Carad Chemical Company, Redwood City, California, for production of DMS using the straightforward and expensive nitric acid oxidation route.

The plant capacity installed by Crown Zellerbach should be sufficient for the American

continent at present. However, if du Pont and Chemstrand changed to DMSO as solvent for their acrylic fibres, the supply situation may well have to be examined.

Plant Working Well

The new plants at Bogalusa for DMS and DMSO have been performing up to expectations and the quality of the products produced is described as excellent. This is particularly true of DMSO which as previously available had a disagreeable oduor. The Crown Zellerbach product is reported to be pure and odour-free.

Applications and Future Potentialities

Reports confirm that the largest single use for DMSO to date is in the spinning of polyacrylonitrile fibres. There is also considerable interest in the use of this product as a solvent for difficult-to-dissolve pesticides. In cleaning up polyurethane foaming equipment DMSO has given excellent results. In this connection the very low toxicity, lack of odour and low flammability of the product make it extremely useful for this purpose. Another potential wide application involving polyurethane is the manufacture of elastic threads from polyurethane, using DMSO as a spinning solvent.

In Italy and Japan manufacture of sugar esters on a pilot scale has been under development. At present dimethyl formamide is being used as solvent in which to carry out the esterification; DMSO, however, shows considerable promise in this field, it is reported, particularly because of its low toxicity. It is also expected that DMSO will find a useful application where the more common solvents such as acetone, alcohols, etc., are not so satisfactory. DMSO will not dissolve paraffins and hence it is being investigated by a number of U.S. companies as a selective solvent for the separation of aromatics from paraffinic compounds.

At this time the only commercial application for DMS is as a gas odorant, but other uses are being investigated. Crown Zellerback believe that there will be steadily increasing sales of this product.

Fluidization for Red Iron Oxide Manufacture from Ferrous Sulphate

PRODUCTION of red iron oxide from ferrous sulphate has been investigated by Tibor Blickle, of the Hungarian Research Institute for Chemical Heavy Industry. Three stages are required in processing: (a) dehydration, (b) oxidation and roasting of ferrous sulphate in a fluidised bed, (c) washing the raw pigment by fluidisation with water, and purifying the effluent gases by "foam" columns.

Dehydration, oxidation and roasting are carried out in a three-bed reactor. The most favourable conditions for pigment manufacture, the Hungarian researcher reports, were when the top layer is at a temperature of 200°C and a gas flow-rate of 30-35 cm/sec.; the middle layer, at a temperature of 500°C ferrous sulphate, is completely oxidized and the solid matter obtained contains no moisture; the bottom layer is at 700°C, residence period of 1 hour and a gas flow-rate of 49 cm/sec. The product obtained contains 96% iron oxide.

The pigment slurry is fed continuously in little clusters or lumps into the top fluidised bed where it agglomerates to form small granules which dry. Optimum conditions for fluidised roasting of the material obtain, Blickle reports, when the average grain size of iron is below 6 microns. By increasing the rate of air rate of decomposition is increased. The basic ferrous sulphate decomposes very slowly and forms a flocculant precipitate and iron oxide. Due to its lower specific weight, the precipitate can be recovered by water washing. Conventional sedimentation requires three vats of 80 cu. m. capacity to wash 100kg. of iron oxide, but with a fluidisation washer 3 cu. m. of water is sufficient. Also with the sedimentation method 128 litres of water per kg. oxide is required as against 50 litres per kg. for fluidisation washing. Also, the latter process is continuous and easily mechanized.

The roaster gases, by passing through a foam column containing 8% milk of lime, can be purged of SO_2 and SO_3 before discharge to atmosphere, or they can be used for sulphuric acid production, after dust removal and cooling in the foam column to below 20°C.

current events

CANADA

ERCO's Progress at Port Maitland

Construction work has nearly been completed at the $12 million facility for Electric Reduction Company of Canada Limited—ERCO—which will produce phosphoric acid, triple superphospate, phosphatic fertilizer solutions and industrial phosphates. The plant was due to have been in operation in March, but because of setbacks the on-stream date has been delayed.

When the plant is completed its production capacity will be sufficient to supply Canada's total annual consumption of triple superphosphate—estimated at 50,000 tons—plus 5% of the U.S. market, at present about 50,000 tons.

ERCO has concluded an agreement with International Minerals and Chemical Corporation, Skokie, Ill., whereby the Canadian products will be distributed in the U.S.A. by the American company.

Sulphuric acid required in production of the superphosphate will be obtained from Sherbrooke Metallurgical Limited at Dunnville, Ontario, which recently brought its new acid plant into operation*.

New Sour Gas and S Recovery Projects

Approval in principle has been given by the Alberta Oil and Gas Conservation Board to Western Leaseholds Limited for the construction of a $6 million gas processing plant in the Wildcat Hills gasfield, Alberta, some 35 miles north-west of Calgary. Participating with Western Leaseholds, subsidiary of Canadian Petrofina, are Shell Oil of Canada, and Gas, Canadian Pacific Oil, and Gas and Imperial Oil. The plant is expected to begin operating about April 1962 and will produce 75 long tons of sulphur daily. This output is expected to increase to 120 long tons a day.

The board has also advised Shell of Canada that it has approved a plan for its $20 million gas processing plant in the Waterton area. The plant will produce daily 7,780 barrels of liquid petroleum gas, and 1,413 long tons of sulphur. Construction of the plant is expected to be completed at the end of the year.

Home Oil Company and associates have obtained approval from the board for plans to expand their gas processing plant and gathering system in the Carstairs area. It is planned to expand raw gas feed capacity of the plant from 75 million to 229 million cu. ft. daily. Associated with company in this project are British American Oil, Canadian Superior of California, Hudson Bay Oil and Gas, Tennessee Gas Transmission Alminer, Tevaco Exploration, Calgary and Edmonton Corporation, Amuex Oil, Harry Wesley Bass, Southland Royalty, Security Free-

Four acid storage tanks at Erco's Port Maitland facility.

* Sulphur No. 32—Current Events.

hold Petroleum and Shell of Canada. The gas to be treated at this plant contains only small amounts of hydrogen sulphide and this will be removed by absorption. No sulphur is to be produced by Home Oil Company.

Latest approval is for an $11-million project to be built by Saratoga Processing Company, subsidiary of Westcoast Transmission Company and Jefferson Lake Petrochemicals of Canada Limited at Coleman, Alberta. Saratoga will process 75 million cu. ft. a day of sour gas (16% H_2S content) and deliver up to 59 million cu. ft. of gas by pipeline for export by Westcoast. Jefferson Lake will recover 375 long tons a day of sulphur.

This year Canada expects to produce 650,000 short tons of sulphur from sour gas. By 1962 sulphur output is expected to increase to 3,150,000 short tons and thence to reach 4.1 million tons by 1966.

Kimberley Plant for Cominco

At the Kimberley, B.C., plant of Consolidated Mining and Smelting Company (Cominco) of Canada, raw materials in mono-ammonium phosphate production are pyrrhotite used as a source of sulphur, phosphate rock for phosphoric acid from Garrison Montana, and ammonia shipped by tank car from Cominco's ammonia plant at Trail Alberta.

Two Cominco suspension roasters are used to roast the pyrrhotite and sulphuric acid is produced in a single Monsanto-type contact plant with a rated capacity of approximately 300 tons of 100% H_2SO_4.

Iron calcine resulting from the roasting operation is used by Cominco as feed in its pig iron smelter. As the sulphuric acid plant has been in operation for some years, a considerable stockpile of iron calcine has been built up which is gradually being used.

Some coal, or coke, is being used as a reducing agent in the electric smelter, but no coal by-products will be produced. As the capacity of the pig iron smelter increases beyond the output of iron calcine from the sulphuric acid plant, additional ore will be required. This may be obtained by either increasing sulphuric acid plant capacity or additional supplies may be obtained from iron ore deposits.

Sun Oil to Burn H_2S as Fuel

To reduce the sulphur content of a 28° API gravity catalytic light gas oil, Sun Oil Company Limited of Sarnia, Ontaria, is to construct a hydrodesulphurizer unit at its Sarnia refinery. Trickle phase treatment of the gas oil on a cobalt-molybdenum catalyst in a hydrogen atmosphere at a temperature range of 575° to 600°F and a pressure of 550 p.s.i.g. will be used.

The light gases resulting from stripping of the treated charge will be rich in hydrogen and H_2S and will be charged to the refinery fuel gas main and burned in regular gas burners.

UGANDA

Tororo Fertilizer Project

At Sukulu, near Tororo, Eastern Province, Uganda, a superphosphate works with an output of 25,000 tons a year is to be built by Uganda Development Corporation. African Explosives and Chemical Industries Limited has a minority participation in this plant project. Besides the single superphosphate plant a brimstone-based sulphuric acid plant with a daily capacity of 30 tons of 98.5% will be installed. Contractors for the plants are Simon-Carves Limited.

Preparation of the site of the factory to be known as Tororo Industrial Chemicals and Fertilizer Company Limited has already started and the sulphuric and superphosphate plants have been ordered from Simon-Carves for delivery towards the end of this year. It is expected that the plant will be completed by the middle of 1962 and that sufficient stocks will be available at the beginning of 1963 to supply the market.

Manufacture of 20 to 21% P_2O_5 single superphosphate is planned using only about 50% sulphuric acid instead of the customary 63% acid.

Tororo concentrate, which will be used as the source of phosphate, is 40% P_2O_5 with a potential yield of 23-24% P_2O_5 single superphosphate. Most of the beneficiation equipment for Sukulu apatite is available, as there is an existing pilot-plant which, when another ball mill and flotation cell are added, has sufficient

capacity to meet the relatively small scale needs. In addition to apatite concentrate columbium will also be extracted from the ore and will be sold.

All the superphosphate produced will be supplied to local markets; there is no intention yet to export any product.

Uganda Development Corporation regard the project as a pilot project for the future, but it is not known whether the new African-dominated Government in Kenya will support a major project.

UNITED STATES

Tennessee Copper Company's Reconstruction of Sulphur Dioxide Plant

Fire on 7 September destroyed Tennessee Copper Company's liquid sulphur dioxide plant, located next to its No. 2 contact sulphuric acid plant at Copperhill, Tennessee. Exact cause of the fire, which engulfed the plant within a few minutes, has not been determined.

The wrecked sulphur dioxide unit was constructed in 1959, and its replacement was brought into operation on 17 December 1960. The new plant, rebuilt with slight modifications, has a rated capacity of 45 tons a day, the same as the old one. Improvements in materials and construction have been made and a few modifications in the dimethylaniline process in use were introduced.

A duplicate unit has been approved and is scheduled to go into production by July this year.

Liquid sulphur dioxide has been produced by T.C.C. of Copperhill since 1949. About two-thirds of the company's sales of this chemical are dependant on the demand for high-quality wood pulp and paper products. Liquid SO_2 is used in the manufacture of chlorine dioxide, a pulp beach, and also in preparing petroleum for sizing and clay for costing. Other uses range from such widely separated processes as production of caramel colouring to the manufacture of glass, while in the metallurgical industry it is used for production of metallic manganese and in heat-treating magnesium castings for jet engines.

Shipment of liquid SO_2 from Copperhill is by railway tank cars, tank trucks, 1-ton drums and 150lb. cylinders. It goes mainly to the U.S. south-eastern states, although customers in Canada, Mexico, Puerto Rico and Western States are also supplies.

Sulphur Recovery at New Hope Plant

Recently completed at New Hope Field, Smackover, Franklin County, Texas, was the New Hope Cycling Plant of the Tidewater Oil Company of Houston, Texas. This plant processes 50 million cubic feet a day of the full well head gas stream which contains 12-14 mol per cent hydrogen sulphide and approximately 180 barrels of recoverable gas-liquids in each million standard cubic feet.

Hydrogen sulphide is removed from the gas in a Girbotol-type gas sweetening unit, and is converted in a modified Claus process sulphur recovery plant, where approximately 180 to 200 long tons a day of liquid sulphur are recovered. Sweet gas from the Girbotol unit is processed through a conventional oil absorption, distillation and fractionation plant for extraction of propane, butane and stabilized condensate.

GERMANY

Uhde's New Acid-gas Scrubbing Process

Friedrich Uhde GmbH, of Dortmund, West Germany, now offers a process which uses water as extraction medium, and the only requirements are that the gas to be treated must have a CO_2 content higher than 10% and be over eight atmospheres pressure. The first user is expected to be a petrochemical producer in Western Europe which cleans its 15% CO_2 and 15% H_2S streams at present by chemical means.

Water scrubbing requires lower capital investment and operating outlays while the absorption capacity of water increases with pressure. The volume of water needed is not large and hence equipment size and other utility requirements are below that of other systems.

Uhde's process is based on the classical flow sheet, but has several improvements. Two features involved are reduction of dissolved methane losses, and improvement of the method of removing H_2S from the water stream.

Gulf Sulphur Merger and Reorganisation Completed

"In order to establish a position in the market and to meet competition in certain instances, the company has been compelled to make sales below the quoted prices."

Robert H. Allen
President
Gulf Sulphur Corporation

ON 12 January 1961, Gulf Sulphur Corporation was reorganized by merging into its wholly-owned subsidiary, Latino Sulphur Corporation, the name of which was changed to Gulf Sulphur Corporation with the completion of the merger. The effect of the merger has been to convert all outstanding shares of common stock and class B common stock into an equal number of shares of new common stock and to convert each outstanding share of preferred stock into four shares of new common stock.

Mining Operations

Gulf Sulphur Corporation is presently clearing up an area of the Mezquital mine from which it has been producing for more than two years. Current water ratio for production in this area of the mine is reported to be approximately 3,400 gallons. A new area of the mine is being prepared from which the company expects to be producing by the end of the first quarter of 1961.

Sulphur Reserves

The Salinas structure in Lot No. 11 of the Mezquital concessions is being mined at present, and approximately 140 wells have been drilled on this ore body. It is estimated that the Salinas structure contained 5,518,200 proven tons of which about one-fifth has been extracted up to 1 September 1960. Additional reserves of 730,000 tons of sulphur probably exist as a north-east extension of the ore body and there possibly exist additional sulphur reserves of 350,000 tons in the south-west extension of the Salinas structure.

Production and Sales

The company has produced 989,551 tonnes of sulphur between 3 May 1956 and 1 September 1960. Approximately 937,000 tonnes of sulphur has been shipped to the principal sulphur consuming countries of the world, including the U.S., Australia, Germany, France, Great Britain, Israel, India, Belgium and Holland, as well as supplying, to a lesser extent, local customers in Mexico.

The approximately average quoted prices per long ton of dark sulphur f.o.b. Coatzacoalcos, Mexico, were:—

Year	Quoted Price	Year	Quoted Price
1956	$25.00	1959	$21.50
1957	$23.00	1960	$21.50
1958	$22.00		

Quoted prices per long ton of bright sulphur in this same period average approximately $1 more than for dark sulphur. Approximately 90% of the company's sales are of dark sulphur. To establish a position in the market and meet competition in certain instances, Gulf Sulphur has made sales below the quoted prices. The cost of servicing sales of sulphur is less than 2% or gross sales of the company and remains relatively constant.

The decline in the company's production during 1960 was attributable principally to its operations being carried on in a depleted section of the mine. A new section of the mine now being prepared for production is expected to be producing by the end of the first quarter of 1961.

High-purity Sulphur

In recent months the company's production has consistently maintained a purity level of 99.6%. By acid-treating a sulphur of 99.9% purity is obtained to meet the requirement of certain of Gulf Sulphur Corporation's customers.

The company has contracts for the delivery of 500,000 tonnes of sulphur for the period 1961 to 1966 whereby 100,000 tonnes is to be delivered in 1961 and the balance equally over the succeeding five years.

During the first eight months of 1960, three customers accounted for approximately 47.7% of the company's total sales and the largest single customer accounted for approximately 22%.

Marketing

In order to place itself in a better competitive position, Gulf Sulphur Corporation has established a bulk sulphur stockpile near Tampa, Florida, and is considering the establishment of other stockpiling

Liquid Sulphur

Sulphur in liquid form is being transported by barge down the Coachapa and Coatzacoalcos Rivers to the company's filtering dock and storage facilities at Puerto Mexico. Gulf Sulphur has three barges—two of 600 tons capacity and one of 470 tons—for transporting liquid sulphur, and 22 other craft. Puerto Mexico has dock facilities where sulphur can be loaded on

ships up to 15,000 tons. Capacity for storage facilities is 100,000 tons. Filter capacity at the dock is 250 tons a day. The company has also established a bulk sulphur stockpile near Tampa, Florida, and is considering the establishment of other stockpile sites.

Finances

Sales of sulphur (net of allowances, commissions and delivery costs) for the company were $561,213 (nil in 1959) and $3,967,841 ($4,228,847 in 1959) for the first eight months ended 31 August 1961. Net income (loss) before depreciation, depletion and amortization was $192,164 ($228,666 loss in 1959) and $118,260 ($416,744 in 1959) for the first eight months of 1960. Net income (loss) was $193,388 ($230,466 in 1959) for the company and $552,696 ($169,138 in 1959) for the consolidated company.

Share Offer

Gulf Sulphur Corporation are offering 120,000 shares of the new common stock to Pan American Sulphur Corporation in exchange for the $100,000 debt. The company is also negotiating for a settlement of its obligations in respect of the accrued royalty and for a reduction in future royalties. In respect of production 1 April 1960 to 31 August 1960, some $574,000 is owed.

The company is also in arrears in royalty payments to several individuals and to cancel all private royalty interests in the Mezquital concessions on 1 July 1960 the company has offered 3,364,256 shares.

Freeport's Sulphur Sales Reached 2·2 Million Tons But Competitive Conditions Kept Prices Down

"Tonnage sales ran ahead of sales in 1959, totalling 2,200,000 tons. We received less revenue per ton because of competitive conditions. However, sulphur process in some of our markets took a modest upward turn towards the end of the year."

Langbourne M. Williams
Chairman

Charles A. Wight
President

Freeport Sulphur Company
Wilmington, Delaware

HIGHLIGHTS of 1960 for the Freeport Sulphur Company were the commencement of sulphur production at the two new mines, Grand Isle and Lake Pelto, and the inauguration of a new liquid sulphur distribution system. Shutdown of its subsidiary's nickel cobalt plant at Moa Bay as the result of the action of the Cuban Government and seizure of the company's properties in Cuba were described by the directors as a " severe blow."

There was a modest increase in net production and sales of oil by the Freeport Oil Company and National Potash Company in which Freeport Sulphur has an interest enjoyed a small profit in 1960 for the first time since it commenced production in 1957.

Sulphur Demand

In 1960, demand for sulphur in all forms increased for the second consecutive year, and both domestic consumption and exports reached new peak levels. The record year of the U.S. phosphate fertilizer industry is described as " a major factor in improving the sulphur market." Abroad demand was particularly strong as the result of a high level of activity in virtually all sulphur-consuming industries.

Tonnage sales by Freeport were greater than those in 1959, totalling 2,200,000 tons. Less revenue was received per ton, however, because of competitive conditions, but sulphur prices in some of the company's markets rose modestly towards the end of the year, reversing the downward trend that began in 1956.

During 1960 Freeport produced as much sulphur as it sold. As in previous years, the bulk of production came from the Grand Ecaille and Garden Island Bay mines and from Chacahoula. The total included initial output from the two new properties, Grand Isle* and Lake Pelto†.

Because of a strong and growing customer preference for liquid sulphur, Freeport is arranging for new facilities capable of moving very large quantities of sulphur into major U.S. market areas for storage and transhipment to customers. The programme includes new liquid storage terminals on inland waterways and tanker terminals in Florida and on the Atlantic coast (see P.36).

Finances

Net earnings in 1960, after all charges including depreciation, amortization and provision for taxes, amounted to $13,193,537 or $1.78 per share compared with $14,477,796 or $.93 per share in 1959.

Gross sales for 1960 were down by 0.9% to $52,996,554 ($53,233,634) and operating and development costs general expenses, etc., increased from $38,237,797 to $39,305,791.

Operating losses, as reflected in the consolidated tax return, were, at the end of 1960, considerably greater than the profits of Freeport Sulphur. To preserve losses for utilization in future years, and for other purposes, Freeport Sulphur at the end of 1960 made a forward sale of a portion of the net proceeds from future sulphur production of $50 million. The company estimates that in the course of normal operations, this amount will be liquidated in about two years. Funds obtained from this forward sale of sulphur proceeds are being treated as deferred income.

* Sulphur No. 28, May 1960. † Sulphur No. 32, February 1961.

PASCO's New Records in Production and Shipping, and Major Advances in Liquid Sulphur Plans

"Without question, to remain an important factor within the world's sulphur industry, initiation of liquid sulphur movements — on a broad scale — has become absolutely necessary."

Harry C. Webb
President
Pan American Sulphur Company

DURING 1960, Pan American Sulphur Company expanded, and new records were achieved. Thus sulphur production by PASCO to 31 December 1960 exceeded 1 million long tons (887,000 tons). The company's shipments also broke previous records, exceeding 900,000 long tons (850,000). Sulphur stocks were at the record level of 659,596 long tons and net sales for the year amounted to $18,980,112 ($17,869,140), a new record.

Total production since September 1954 amounts to 4,507,028 long tons and shipments which began in 1959 to 3,837,283 long tons.

Liquid Sulphur Deliveries

While 1960 was a record year, Mr. Harry C. Webb, PASCO's president, considers that the company's development of a far-reaching and highly flexible liquid sulphur delivery programme will prove invaluable to its future growth and stability. Under the current industry-wide programme, liquid sulphur may be purchased by practically every U.S. consumer if desired. "Without question," states Webb, "to remain an important factor within the world's sulphur industry, initiation of liquid sulphur movements—on a broad scale—has become absolutely necessary."

Deliveries have been made to practically every important sulphur consuming area of the world, and last year 183,000 tons of sulphur passed through the company's Tampa, Florida, terminal. To effect deliveries 180 ships were loaded—a record.

During the year under review a 1,000 tons liquid storage tank and sulphur filtration unit were installed.

Interest in molten sulphur delivery from the Tampa terminal has been such that Pasco has executed sales contracts covering sufficient tonnage to justify a major liquid sulphur delivery programme beginning May this year (1961). A chartered T2 tanker of 15,000 tons capacity is being employed and a long-term contract for it has been negotiated. The tanker will remain in constant Pasco service and will move approximately 400,000 tons of liquid sulphur annually.

First shipments of liquid sulphur in the company's chartered T-2 tanker will start about 15 May. Total costs of necessary handling and storage facilities will be approximately $2,500,000.

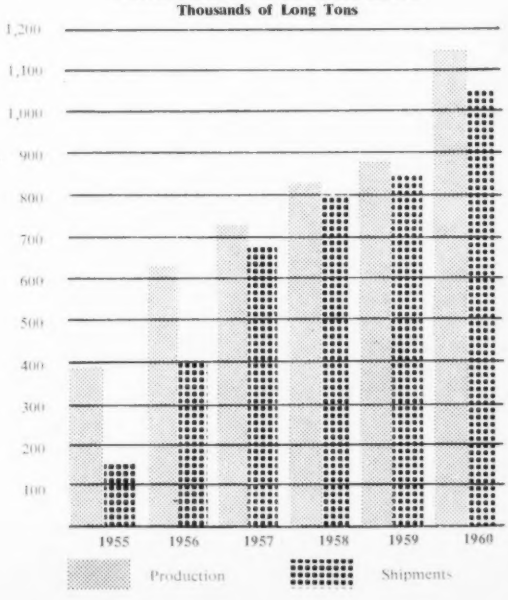
Sulphuric Acid Pilot Plant

A 15 tons a day sulphuric acid plant is now in operation at Jaltipan Dome. It provides acid for the company's sulphur purification process and a programme has been planned for studying acid plant variables.

Sulphur Price Increase

World-wide competition and oversupply of sulphur resulted in unabated price competition during 1960 with prices in certain areas reduced to the lowest point of the past decade or more. With per-ton net income gradually deteriorating, production costs, royalties and taxes were increasing. PASCO therefore decided to increase the price of sulphur by $2 a ton; this price increase came into effect on 19 December 1960 for all new business and will be applied to all current business as contracts permit. Income resulting from this price increase is not expected to be importantly reflected until the second half of 1961 and during 1962. Sound production requisites and procedures demand that sulphur domes be thoroughly depleted before abandonment. To fulfill this promise sulphur prices have had to be revised to a point of realism and practical economic requirements.

PRODUCTION AND SHIPMENTS
Thousands of Long Tons



PASCO expects production during 1961 will balance shipments estimated at approximately 1 million tons. Stocks will not be increased over those available at 31 December 1960.

Finances

Net sales for 1960 were $18,980,112 compared with $17,869,140 for 1959, a new record. Net income was $3,118,670, a reduction from the previous year of $343,720. Pre-share earnings amounted to $1.35, as against 1959's $1.50. PASCO continued to maintain a working capital of over $10 million during 1960. Net cash was $3,994,493 and provided for depreciation and depletion of $715,739; for future income taxes, $130,000; and the sale of capital stock for option agreements, $30,084. Also the net cash has been used to reduce debts by $760,667; pay cash dividends of $1 per share (a total of $2,309,262), provide for capital expenditure of $926,167 including completion and expansion of the company's sulphur terminal at Tampa, Florida, and construction of the 15 tons a day sulphuric acid plant at Jaltipan, and increase working capital and preferred expenses by $387,731, including that resulting from reduction of $380,333 due on the Export-Import Bank loan.

Outlook

Satisfactory progress, consistent with increased product demands, has been achieved. Notwithstanding severe competition of a world-wide nature, it is anticipated that 1961 production and net sales will compare favourably with results for 1960.

Total production during 1961 is expected to balance shipments, estimated at approximately 1 million tons. Stocks will not be increased over tonnage available on 31 December 1960.

Texas Gulf's President, Claude O. Stephens Expects Firming of Sulphur Prices in 1961

"In a year generally characterized by faltering production indexes, we are heartened by the performance of the sulphur industry. This trend reinforces our confidence in the long-term growth of the sulphur industry in the 60's."

Claude O. Stephens
President
Texas Gulf Sulphur Company

SULPHUR industry in the free world set up many new records in 1960, Mr. Claude O. Stephens, president of Texas Gulf Sulphur Company, reports:—

- World production and consumption of sulphur reached new record levels.
- U.S. consumption was at a new peak level.
- Exports from the U.S. topped their previous high level set in 1956.
- Production of sulphur in the U.S. by the Frasch method rose again, reversing the trend in the past three years of declining production.
- New production records were set in France and Canada.

Although the increases recorded in the U.S.A. were not great, in a year generally characterized by faltering indexes, the performance was heartening. The trend reinforced confidence in the long-term growth of the sulphur industry in the 60's. Mr. Stephens indicated in his review that he expected 1961 to be a year "which sees a trend towards the firming of prices in world sulphur markets"—a trend which began towards the end of 1960.

France as Competitor

France was beginning to emerge as an important competitor in the world sulphur market, Mr. Stephens reported. His own company, he noted, has pioneered sulphur recovery from natural gas in North America, with a plant at Worland, Wyoming; and now also operates a similar major recovery plant at Okotoks, Alberta.

Molten Sulphur Terminals

For consumers of sulphur, the most noteworthy development of 1960 was the fast-growing trend towards shipping sulphur in molten form. Texas Gulf, which has been a pioneer in shipping molten sulphur, now has four central terminals in the eastern U.S. to handle molten sulphur. Mr. Stephens estimates that by the end of this year over 40% of all the company's sulphur shipped will be in molten form.

Finances

Earnings of Texas Gulf Sulphur in 1960 amounted to $13,718,081 ($1.37 per share) compared with $13,338,360 ($1.33 per share) in 1959. Included in the year's earnings were extraordinary items amounting to $1,033,845, equal to 10 cents per share. The latter resulted from refund claims on prior years' income tax, and were offset in part by a loss sustained on the investment in the company's Mexican subsidiary which discontinued operations in early 1960.

Gross revenue from sales in 1960 amounted to $58,935,424 as against $63,596,936 in the previous year.

CRUDE SULPHUR IMPORTS INTO WESTERN EUROPE (Average price per metric ton)

SOURCE	Belgium/ Luxembourg Annual	Finland Annual	United* Kingdom Annual	Netherlands Annual	Sweden Annual	West Germany Annual	Norway Jan.-Nov.	Denmark Annual	France Jan.-Nov.
United States									
1960	66,018†	20,811	300,990	74,135		70,732			
	£9.30	£10.89	£10.34	£9.08		£9.82			
1959	74,484	22,504	265,472	30,878	21,279	62,490			
	£9.98	£11.25	£10.57	£8.99	£10.44	£10.20			
Mexico									
1960	74,634†		90,824			55,602			
	£9.00		£9.84			£9.09			
1959	29,113		66,381	19,610	5,759	8,519			
	£8.92		£10.29	£9.03	£9.62	£9.44			
France									
1960	32,283†	39,800	102,901	21,627		45,800			
	£9.39	£10.90	£10.44	£8.98		£9.92			
1959	23,519	18,173	49,521	7,763	4,295	30,373			
	£10.00	£10.60	£10.87	£9.38	£10.57	£10.18			
Netherlands									
1960	5,375†								
	£9.16								
1959	8,314				2,604				
	£9.21				£10.57				
U.S.S.R.									
1960	5,036†	15,284		1,009		4,097			
	£8.72	£9.71		£8.60		£8.63			
1959		9,252							
		£11.50							
Norway									
1960		18,693							
		£11.14							
1959		18,984			34,503				
		£11.19			£11.09				
East Germany									
1960		5,081							
		£10.60							
1959		2,000							
		£10.83							
TOTAL									
1960	**183,346†**	**99,669‡**	**486,900‡**	**96,826‡**	**78,294**	**176,263‡**	**5,136**	**5,612**	**138,734**
	£9.17	**£10.74**	**£10.43**	**£9.59**	**£10.72**	**£9.59**	**£10.72**	**£11.73**	**£9.89**
1959	**135,722**	**70,913‡**	**381,374‡**	**58,251‡**	**68,450‡**	**101,418‡**	**895**	**2,579**	**187,116**
	£9.71	**£11.09**	**£10.56**	**£9.06**	**£10.72**	**£10.14**	**£13.35***	**£14.07****	**£9.13**

† Preliminary figures. ‡ Excludes small amounts of specialised types of sulphur. ** Includes specialised sulphur.

* Values calculated from customs returns.

PYRITES IMPORTS INTO WESTERN EUROPE

SOURCE	Belgium/ Luxembourg Annual	Denmark Annual	France Jan.-Nov.	Italy Jan.-Nov.	Netherlands Annual	United Kingdom Annual	West Germany Annual	Sweden Annual
Eire								
1960	12,866					7,270	1,805	
1959					945	1,277		
Italy								
1960					169,832		863	
1959					110,721		969	
Yugoslavia								
1960				79,134			131,814	
1959				32,802			64,035	
Norway								
1960					28,896		298,142	
1959					19,766		197,540	77,572
Portugal								
1960	158,859				66,901		71,172	
1959	66,499				100,159		63,104	
Sweden								
1960						26,211	3,042	
1959						26,882		
U.S.S.R.								
1960							1,340	
1959								
Finland								
1960							139,982	
1959							29,076	
Spain								
1960	176,921				31,965	22,269	601,605	
1959	116,896			17,994	22,820	23,074	523,156	
Turkey								
1960							54,067	
1959							46,152	
Cyprus								
1960	64,848			169,166	65,545	213,546	330,551	
1959	82,170			82,376	110,616	139,061	384,999	
Greece								
1960					15,580			
1959					14,430			
Canada								
1960						10,255	22,015	
1959						26,909		
Cuba								
1960	16,191						60,638	
1959							24,943	
Morocco								
1960							1,963	
1959								
Total								
1960	**429,704**	**152,594**	**456,646**	**270,180**	**378,718**	**279,553**	**1,718,999**	**97,145**
1959	**270,256**	**129,742**	**432,131**	**139,746**	**379,579**	**217,203**	**1,334,099**	**77,572**

Dark SULPHUR

from
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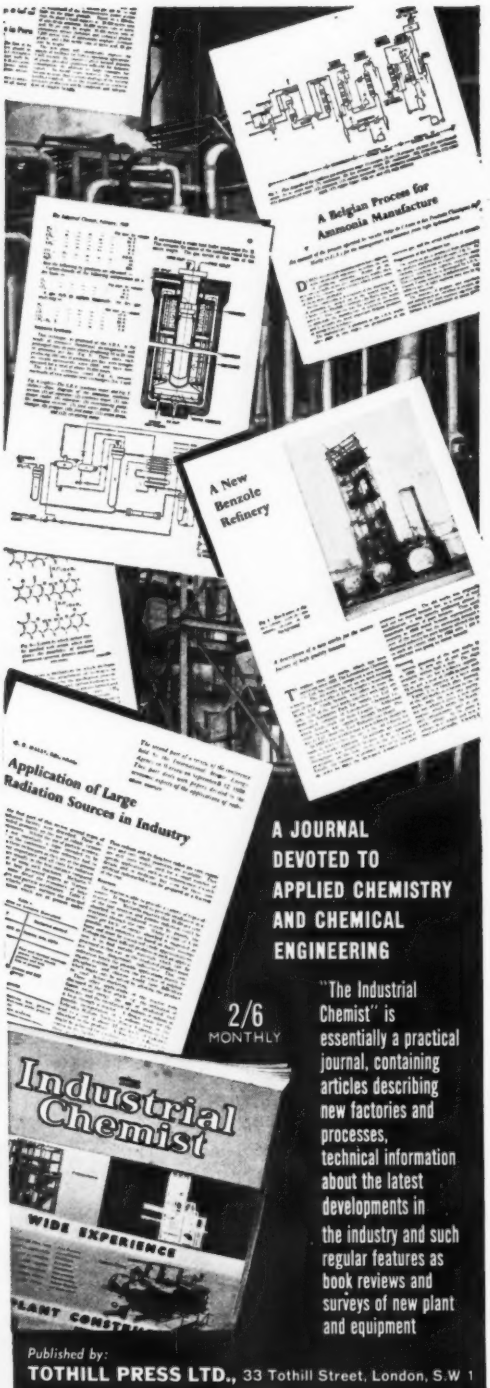
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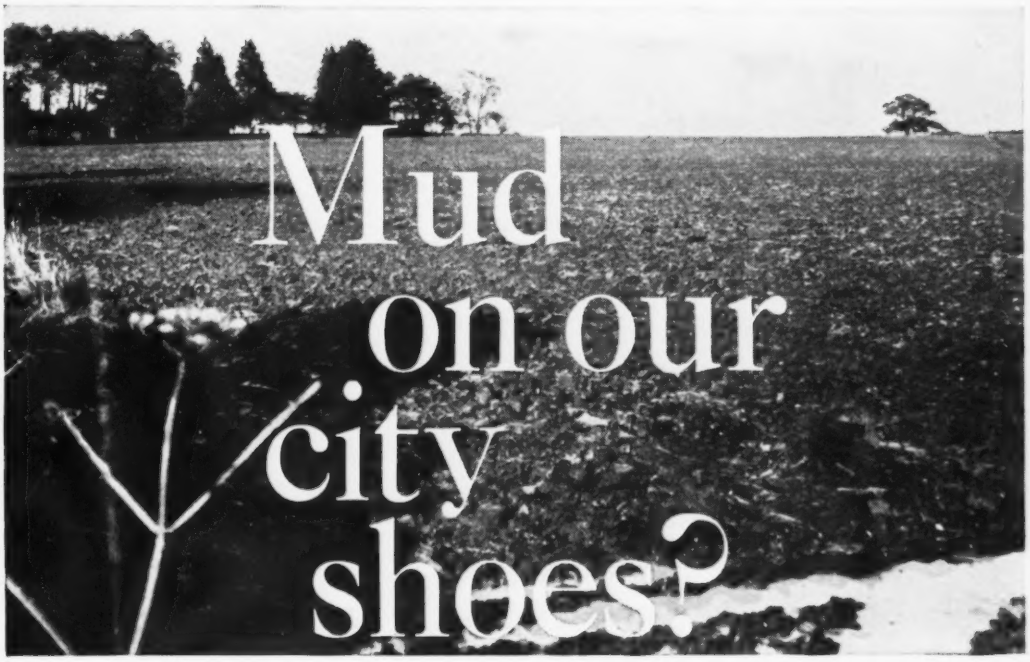

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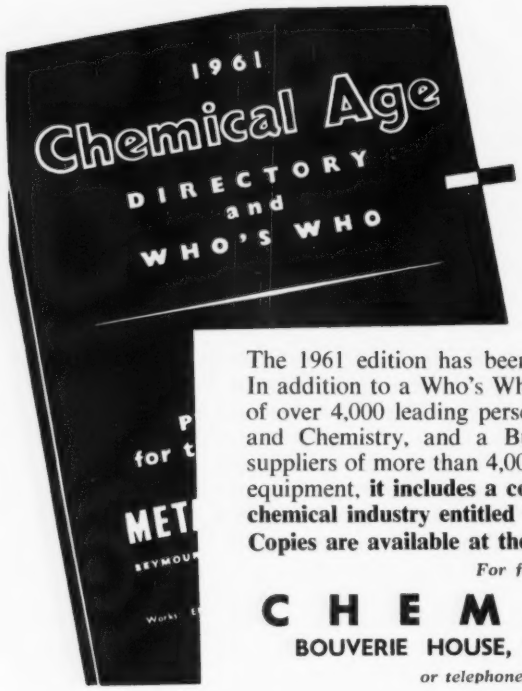

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